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SCIENCE FOR THE BLIND

By PROFESSOR W. G. BICKLEY, D.SC., F.R.A.E.S., A.C.G.I.

Anyone who, being a mathematician or a scientist, loses his sight after leaving school—or, *a fortiori*, in mid-career—cannot easily escape feelings of deep dismay at the bleak prospect before him if he hopes to continue his studies or his creative work. He—or she, of course—will have little difficulty in learning braille, and will, in the course of a month or so, be able to absorb, with gratitude and enthusiasm, such information as is available in that script of six embossed dots. But, when he comes to the point of exploring the catalogue of (braille) printed books published by the R.N.I.B., that of transcribed books in the National Library for the Blind, and even that of the R.N.I.B. Students' Library, his hopes will be dimmed and his courage may well falter. His perusal of the monthly list of announcements will also be a recurrent disappointment. Were he a historian, a linguist, a philosopher, a lawyer . . . he would still find himself bereft of direct access to the more ephemeral specialist literature, but he would find a large selection of the important standard works in his subject already transcribed into braille, and, as new books came out, he would find no great difficulty in getting them transcribed for him by the large band of devoted sighted transcribers to whom the blind world owes so much. Be he, however, a mathematician or scientist, he will find only a pitifully small, random, unrepresentative selection of books for him in braille. There are practically no books to be bought at any level higher than 'O' Level of the G.C.E. on science or mathematics. There are, in the Students' Library, a few—and the number is slowly increasing—more advanced books on scientific or mathematical topics, but any systematic study is possible only with the aid of a sighted reader who needs to be technically competent—with whose help the blind mathematician or scientist can make his own braille notes for reference. Add to those who lose their sight later in life the children in our schools for the blind, and it can be said in truth that, for the blind, the door into the world of science and mathematics is hardly ajar, and entry, if not quite prohibitive, can be described only as 'difficult'!

In our scientific and technological civilization, when we are doing so much to enable and encourage the blind to share more and more fully the life of the sighted community around them, and when so many of the aids being invented and developed to enable them to do this are based on scientific principles and techniques, the fact that so little seems to have been done, and such meagre success so far achieved, in providing facilities for the blind to become better acquainted with these topics calls for some explanation.

Some will, of course, say that, even in the sighted world, only relatively few people have more than a

smattering of science, or regard it as anything more than a provider of detergents and hydrogen bombs. It is true that such ideas are prevalent and, so far as they are, it is deplorable—but science is much more than this. It is a way of thought, an approach to life, a dispassionate search for truth, coupled with a belief that there is truth to be found by this patient search, truth outside the ambit of subjective considerations and of emotional aberrations, truth that is ultimately incontrovertible, and that this scientific attitude of mind has already made, and will continue increasingly to make, important and essential contributions to human progress. There is every reason for enabling and encouraging the blind to share in all this!

The need is indeed so evident and the desire so natural that one is led to ask whether the meagre facilities which exist for their fulfilment imply some insurmountable difficulties. Difficulties there may be—but surely not all of them insurmountable!

The first difficulty is that, in science and mathematics, it becomes at an early stage impossible—or, at least, cumbersome and inconvenient—to express the ideas concisely and precisely and convey the information by the unaided use of ordinary everyday language. In mathematics and in those sciences which are to any extent mathematical, in chemistry, and generally throughout science, abbreviations and symbols are freely used. Even a direct transcript into braille of the literal symbols—where possible—will not always be unambiguous and the uses in ink-print of various founts of type, of the relative position of letters and numerals to convey specific and precise information, as well as, of course, many non-literal symbols, are not immediately transcribable into braille. A code has to be constructed. The need is greatest in mathematics, and a braille mathematics code was published under the aegis of the National Uniform Type Committee in 1955 for use in Britain. This code does—as the present author can testify—enable quite abstruse mathematics to be represented in braille (cf. articles by the present writer in *The Times Educational Supplement*, 22 February, 1957, and the *New Beacon*, September, 1960). In so far as other sciences are mathematical, this code serves, but it does not meet their needs in all respects—especially, perhaps, chemistry—and it is significant that the 1917 Taylor code caters for chemistry as well as for mathematics. Having sponsored the mathematics code, the National Uniform Type Committee saw the desirability of setting up a committee to consider and report upon the needs of other sciences. The first instalment of the report has now been published (*Braille Science Notation, Section I*, R.N.I.B., one pamphlet), and its publication provides the occasion for this article.

This first section commences with several paragraphs devoted to general considerations, and then proceeds to deal with elementary chemistry. A code is developed giving symbols for the chemical elements and rules for their use, which enables formulae for inorganic and the simpler organic compounds, and also some of the symbolism of physical and electrochemistry, to be transcribed into braille. A list of the known elements, the symbols for them, and their atomic numbers, is included. Representative examples of the symbols and their combinations are provided throughout. The section concludes with a list—two lists, in braille and alphabetical order respectively—of recommended 'Short forms and contracted words' (two or three cell), for many commonly occurring scientific terms. The use of these contractions is optional, and should be sparing in the elementary texts, but would conduce to brevity in advanced ones.

Further sections are expected shortly. The second will be a transcription of a pamphlet, 'Symbols, Signs and Abbreviations recommended for use in British scientific publications,' published by the Royal Society, along with the braille equivalents suggested by the committee. The third section, which is practically ready for the press, will be devoted to the structural formulae of organic chemistry. For these a concise code has been constructed which will enable the blind student to record intelligibly in braille the structure of quite complicated organic compounds, and which will to a large extent obviate the embossed reproductions of the diagrams which appear in printed books on organic chemistry. Further work is contemplated, and that on the coding of electrical and electronic circuits is being actively prosecuted.

But to open the doors of mathematics or chemistry to the blind, the provision of braille codes, although necessary, is not sufficient. Further difficulties remain to be surmounted. The sighted transcriber having learned braille can transcribe history as well as novels. Works on technical subjects, such as law or philosophy, can be transcribed without an understanding of their content. In these cases, coding is *independent of meaning*.

For the sciences and mathematics this is—unfortunately but inevitably—*no longer true*. Quite apart from psychological considerations, such as lack of concentration or of interest, one *cannot* transcribe into braille mathematics which one does not understand. The same is true of chemistry, and this limits severely the number who, however willing, would be able to transcribe into braille books on more advanced scientific topics, for the Students' Library or any other library for the blind. This restriction becomes the greater as the standard of the book to be transcribed becomes higher. It also imposes a greater load—more to learn, more to remember, and a closer attention to detail—upon the transcriber. But let us hope that all this will act

rather as a challenge than as a deterrent to those who, having the technical knowledge, wish to help the blind in this way. Since the introduction of the mathematics code, some members of the staff of the Students' Library have become proficient in its use, at least as far as proof-reading the volumes on mathematics being transcribed is concerned. Some mathematicians have joined the band of voluntary transcribers upon whom the supply of new braille volumes for the library depends, and the results of their labours are slowly flowing into the library. But many more would still be welcome, and now there will arise a need for chemists, physicists and other scientists. For people with the requisite technical knowledge, leisure to give, willingness to learn basic braille and the appropriate code, and perseverance to carry them through the learning and training period, there is an abiding need, and only by a continuous flow of new transcribers can the door to science for the blind be opened wider and kept open.

Another difficulty which the blind inevitably experience is that of practical work in science. But even there progress is being made—spectacular progress, for instance, by Abraham Wexler, in Melbourne, whose book on the subject is to appear soon.

Another aspect of the problem we are considering is the relative smallness of demand. But the economists' cliché that 'demand creates supply' is only a half-truth. Modern advertising is a continuous and successful set of variations on the theme that 'supply creates demand'!

As popular and specialist books on mathematics and science appear on the shelves of the braille libraries, they *will* be read, and by an increasing number of readers.

When the remaining sections of the report of the Braille Science Notation Committee are published, the committee will have finished its immediate work, and the first obstacle to science for the blind will have been removed. What then remains is to recruit a band of sighted transcribers who will use these codes to build up a collection of braille books on mathematics and science of a range and standard comparable with those of the other specialist collections already in existence and being expanded. Will some of those who have the leisure and the knowledge of, and interest in, mathematics and science come forward and help us in this way? They will, I believe, find the work both interesting and rewarding, and will earn a share of the deep gratitude which we blind feel to all those whose voluntary labours fill the braille libraries with the books which mean so much to us.

Science for the blind has resembled the mediaeval maps of the dark continent—empty, or decorated with fabulous and unreal objects. With the aid of the new braille notation we can begin to fill up the empty spaces and replace the legendary monsters by truth.

NEW METHODS OF POLYMERIZATION

By K. C. BRYANT, M.A., B.SC., F.R.I.C.

Fawley Research Manager, Monsanto Chemicals Ltd*

The general aim of polymer research is to be able to produce, at will, polymers of known structure and properties. This implies that we must find out how to control molecular parameters such as crystallinity, molecular weight, molecular-weight distribution and so forth. New methods of polymerization are of particular interest when they lead towards this objective. They may result in new products which had not been made before, *e.g.* crystalline polypropylene and polystyrene, or in the availability of polymers which could not previously have been made and sold at a price that would make it possible for them either to compete with existing materials, or to find novel uses, *e.g.* polybutadienes.

I shall try to demonstrate to you not only the power of some of the methods now available to us, but also the range of conditions under which we can carry out polymerizations when we are attempting to develop new techniques or new principles. I do not propose to confine myself to methods used for polymerizing hydrocarbons, but to touch on a wide variety of techniques and a range of monomers. With the extension of monomers to include formaldehyde and acetaldehyde and the appearance of processes for making acrylonitrile, acrylates, acetates and so on from propylene, 'Chemicals from Petroleum' can include almost anything that contains carbon. With Esso making butyl rubber at low temperatures, and many people making polyethylenes at pressures above 20,000 p.s.i., one hesitates to exclude any polymerization technique on the grounds of engineering difficulties.

Polymerization reactions can be divided broadly into condensation reactions, where bifunctional molecules

Condensation

Adipic Acid + Hexamethylene Diamine → Nylon 66
Terephthalic Ester + Ethylene Glycol → Terylene

Addition

Ethylene Oxide → Polyethylene Oxide

Vinyl

(a) Free Radical

Styrene $\xrightarrow{\text{Peroxide}}$ Polystyrene

(b) Cationic

Isobutylene $\xrightarrow{\text{AlCl}_3}$ Polyisobutylene

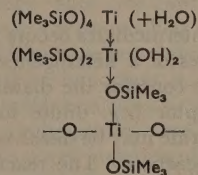
(c) Anionic

Isoprene $\xrightarrow{\text{Li}}$ *cis*-1:4-polyisoprene

react with or without the elimination of by-products, *e.g.* water; addition reactions, where cyclic saturated

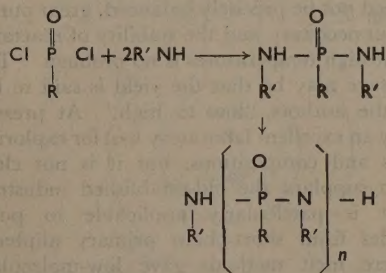
molecules open their ring and add to one another; and vinyl polymerizations, where unsaturated molecules add to one another, one of their double bonds disappearing. (Presumably formaldehyde falls in this last category.)

Condensation processes have long been known, but in recent years they have become of interest in two different directions. Firstly, much work has been carried out, in the United States and the Soviet Union particularly, on the preparation of polymers containing metallic or at any rate non-carbon atoms in their main chain, primarily in attempts to make temperature-resistant products. In principle the method used, for example, by Andrianov, is to prepare organometallic compounds that can be partly hydrolysed to yield dihydroxy compounds. These then condense to give compounds of high molecular weight with, for example, aluminium in the backbone. Trivalent elements such as aluminium



and tetravalent ones such as titanium and zirconium can be used, and, with a mixture of alkoxides, two or more metals can be introduced into the main chain. However, it is not clear how or whether the structure can be controlled.

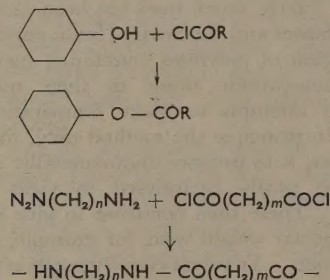
PON polymers can also be prepared in this way, *e.g.*



Secondly, an extremely interesting technique of carrying out a variety of condensation reactions was discovered two or three years ago by the du Pont workers Wittbecker and Morgan. Polycondensations are frequently based on slow reversible organic reactions,

* Based on a paper delivered at the Symposium on 'Chemicals from Petroleum', Southampton, on 20 April.

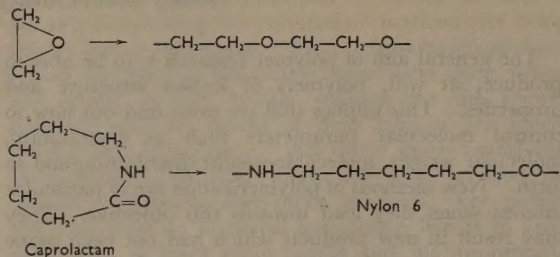
for example between a diamine and a dicarboxylic acid, needing a high temperature and reduced pressure to remove the by-products of low molecular weight, *e.g.* water and alcohol. Many polyamides and polyesters have been successfully prepared in this way, but they have been limited to intermediates and polymers stable under the severe conditions usually required. Wittbecker and Morgan found that the Schotten-Bauman reaction of an acid chloride with an active hydrogen in OH, NH or SH groups could be made the basis of a simple process which they called interfacial polycondensation. In this, the irreversible condensation of



two fast-reacting intermediates occurs near the interface between two phases of a heterogeneous liquid system. The aqueous phase contains the diamine (for example) and an acid acceptor (*e.g.* dilute sodium hydroxide) while the acid chloride may be dissolved in a chlorinated or aromatic hydrocarbon. The reaction mixture may be stirred, when a granular or powdered product is obtained, or unstirred, when a film of high polymer is formed near the interface and can be continuously removed physically. Experimental evidence indicates that the actual locus of condensation is just inside the organic phase. The advantages of the technique are that polymerization is rapid, the temperature is low, the components need not be precisely balanced, great purity of reactants is unnecessary and the stability of reactants and products at high temperatures is no problem. The chief disadvantage may be that the yield is said to be, and I quote the authors, 'low to high.' At present this is primarily an excellent laboratory tool for exploring new structures and compositions, but it is not clear whether it can supplant the old-established industrial techniques. It is particularly applicable to polyterephthalamides from short-chain primary aliphatic diamines, where melt methods gave low-molecular-weight degradation products, and also to polyamides based on 4:4'-sulphonyldibenzoic acid. (In addition some polyurethanes are less stable to heat, and some polyphenyl esters are not readily made in melt.)

Of reactions in which cyclic monomers add to one another by ring opening, the simplest example is probably ethylene oxide, which can polymerize under a variety of conditions. Propylene oxide can occur in optically

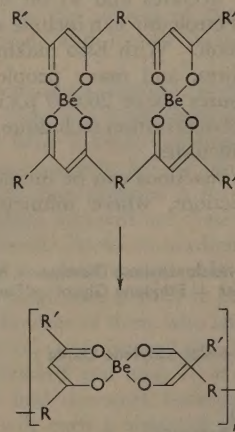
active forms, and whereas caustic potash gives a liquid polymer with the *dl*-form, the *l*-form gives a solid, crystalline, optically active polymer of about the same molecular weight.



A commercial example is the production of Nylon 6 from caprolactam, but the mechanism is quite different. Caprolactam, made from cyclohexanone oxime by the Beckmann rearrangement, undergoes ring-opening and rearrangement in the presence of a little water to give a high-molecular-weight Nylon 6, through an acid-catalysed ammonolysis.

A recent example is the production of polyformaldehyde by copolymerization of trioxan and dioxan, to introduce CH₂ groups to prevent 'unzipping' in Celcon.

A rather spectacular example from the field of metal-containing polymers is the preparation by Klueber and Lewis of the first truly high-molecular-weight soluble beryllium-containing polymer from a monomeric co-ordination compound.

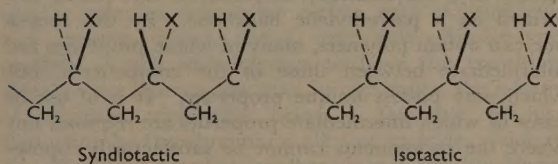


Vinyl polymerizations can be divided into two types, according to their mechanism. Those in the first group are initiated and propagated by a free-radical mechanism, generally set off by, for example, a peroxide or azo compound. Free-radical mechanisms are hardly new, so I shall confine myself to touching on recent developments and showing that stereospecificity need not be confined to the more fashionable Ziegler and other

metallic systems. For those in the second group the mechanism is ionic—either cationic, as with boron trifluoride, or anionic, as with lithium alkyls. I do not propose to become embroiled in any discussion about the mechanism of Ziegler-type polymerization, but I shall place it in the ionic category.

At the time when the first stereospecific polymers were made, it was not clear whether these polymers could only be made with a particular type of catalyst, or whether they could arise from a free-radical as well as an anionic mechanism.

I would like to consider this point in slightly more detail. Firstly, we must bear in mind the structural difference between a stereoregular and an atactic polymer. Not all polymers can exist in stereospecific form, a necessary requirement being two different substituents on at least one of the carbons in the vinyl groups of the monomer. Let us consider the polymer from the monomer $\text{CH}_2\text{-CYX}$. We can then obtain

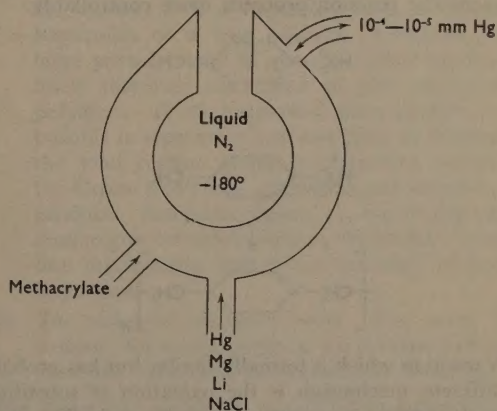


two extreme forms of structure: (i) all the X groups lying on one side of the chain (isotactic) and the Y groups on the other, and (ii) the X and Y groups lying alternately on each side (syndiotactic). The configuration of the significant carbon atom can then be regarded either as always *laevo* or *dextro*, or alternately *laevo* and *dextro*. (The analogy with the configuration of sugars is clear.) This difference is only real because of the tetrahedral spatial configuration of the carbon valencies, and if Y and X are the same the difference disappears. Hence linear polyethylene is not truly stereoregular, its crystallinity arising from the fact that the chain is unbranched, and structurally it differs only in degree from high-pressure polyethylene. However, both the isotactic and syndiotactic forms of polypropylene have been isolated, though this appears to be the exception rather than the rule. It should be noted that these two configurations, isotactic and syndiotactic, are the end members of a series, being the two most regular arrangements. The atactic polymer, where the two groups are arranged randomly along the two sides, can be regarded as a combination of the two end members, and one can regard an atactic polymer as a random copolymer of left-handed and right-handed forms. Similarly, though both polyethylene and polypropylene exist in crystalline forms, their copolymers can be non-crystalline. The interest in the stereospecific forms is that frequently they are crystalline or largely so, and have much more useful properties than the amorphous polymers, for example, higher melting point, stiffness and solvent-resistance.

However, a stereospecific polymer is not necessarily crystalline. Polyacrylates have been made by transesterification of a crystalline polymer, but did not themselves crystallize.

To take a very simple view of the situation, when a monomer approaches a radical or ion chain which is still growing (*i.e.* has an active end), steric factors, among others, will make it slightly easier for the terminal carbon addition of the radical and monomer to approach one another in one configuration than in the other. A bulky group of the polymer will tend to make it difficult for the appropriate carbon of the monomer, which also contains a bulky group, to come close enough to form a chemical bond if the bulky groups are on the same side of the chain. If the temperature is raised, the increased rotations, vibrations and molecular velocities will reduce the difference in the ease of approach in the two cases, and they will become more equally probable, *i.e.* the product is less stereoregular. This explains the experimental observations reasonably well for, *e.g.*, methyl methacrylate polymerized by a free-radical system, when even under normal conditions the syndiotactic form is much more probable than the isotactic, and nuclear magnetic resonance data indicate that this is the predominant form. Factors such as resonance stabilization and polarizability have been ignored in this analysis, but they may well be important in some cases. Polymerization of butadiene in urea or thiourea clathrates, where specific configurations are imposed on the monomer, has also given stereoregular polymers.

If one wants to carry out polymerization at low temperatures, boron alkyls and oxygen or an oxygen-donating material have been used down to at least -60°C , a useful feature of the system being that with boron alkyl alone polymerization proceeds very slowly but becomes very rapid when the oxidizing agent is introduced.

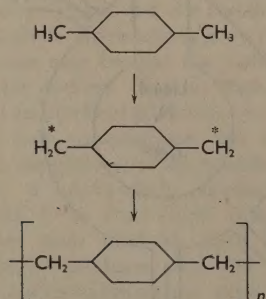


If one really wants to do things the hard way, there is a method developed by a Russian which has been used to polymerize methyl acrylate at -150°C . The

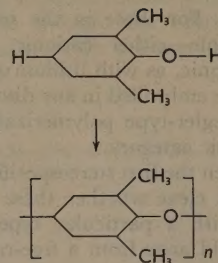
monomer vapour was allowed to enter an evacuated chamber with a cold finger at -180°C at the same time as the vapour of, for example, mercury, magnesium or sodium chloride. After condensation had taken place on to the cold finger, the whole system was sealed and allowed to warm up to -150°C , when very rapid polymerization took place to give a high polymer, said to be isotactic. Unorthodox methods such as this must not be dismissed as irrelevant, since the chemist was here concerned to demonstrate a new principle, the activity of newly-formed surfaces in polymerization reactions.

A temperature-insensitive initiator always has its attractions, at least for laboratory work, and γ -radiation meets this requirement. However, after a period of considerable agitation a few years ago it seems to have receded as an industrial possibility, largely owing to the cost and engineering problems introduced by the need to develop a new technology for the use of large high-intensity sources. Under some circumstances, γ -initiated reactions appear to proceed by an ionic mechanism, but generally a free-radical mechanism seems to hold. An interesting instance here has been the polymerization of solid crystalline acrylamide. This might be expected to give a stereospecific polymer, but though the polymerization took place and the product retained the crystal habit of the monomer, the polymer was amorphous and did not recrystallize after melting.

Free radicals can be produced by thermal decomposition of what we can regard as the monomer. One does not normally place *p*-xylene in this category but when it is heated to about 600°C it forms a di-radical, which then polymerizes. A similar result is obtained with di-*t*-butyl peroxide at lower temperatures. It should be noted that although this involves free radicals, it is not a vinyl polymerization. The polymer is formed by a termination reaction rather than through propagation between radical and monomer. With di-isopropyl benzene the reaction proceeds more controllably.



A reaction which is formally similar but has probably a different mechanism is the oxidation of substituted phenols, when one passes oxygen through the phenol dissolved in an organic solvent containing an amine and copper salt. Linear, crystalline high polymers are obtained with 2,6-disubstituted phenols.



Before leaving this topic graft polymerization must receive at least a passing mention, and I shall refer to block polymerization later. In this former technique, initiating centres are formed on a pre-formed polymer (generally by the action of γ -rays or peroxides on a polymer solution or emulsion) in the presence of a second polymer. Thus, supposing that we irradiate polyethylene with γ -rays in the absence of oxygen, and then admit, say, acrylonitrile, acrylonitrile side-chains are formed on a polyethylene backbone. By this means one can obtain polymers, many of whose properties are intermediate between those of the components, but which may possess unique properties. It is of use in cases in which intermediate properties are required but where the components cannot be satisfactorily copolymerized and the homopolymers are not compatible.

Some cationic systems are of great importance, as in the production of butyl rubber, but comparatively few monomers are influenced by them. Thus one of the tests for the mechanism of a polymerization is to add the initiator to an equimolecular mixture of styrene and methyl methacrylate. If it is a free-radical mechanism an almost 50/50 copolymer is formed, but if cationic, pure polystyrene results.

I now turn to systems that have attracted attention by their yielding a variety of specific isomers; they all contain at least one metal in their initiating systems and are, broadly speaking, anionic in mechanism. Their stereospecificity seems to arise from a particular preferred orientation of the growing chain and the monomer at the surface of a solid catalyst. At this point I must acknowledge my indebtedness to the excellent book on *Stereoregular Addition of Polymers* by Drs Gaylord and Mark.

Historically, Ziegler discovered the system which bears his name when studying the formation of aluminium alkyls from aluminium hydride and ethylene. At $60-80^{\circ}\text{C}$ aluminium triethyl is formed, whereas at $100-120^{\circ}\text{C}$ additional ethylene is inserted at the Al-C bond. With an excess of ethylene, alkyls can be obtained that give high-molecular-weight hydrocarbons on decomposition with water.

Between 120° and 250°C a different reaction takes place in which the long chain appears to be displaced by ethylene with the formation of a long-chain olefin. This reaction was found to be greatly favoured by the presence of a second catalyst such as nickel, but it should

be noticed that no polymerization of ethylene to give a high-molecular-weight polymer had yet occurred. When trying out a variety of co-catalysts, a white precipitate of polymer was obtained by Ziegler when he used zirconium acetylacetonate. When this was explored further it was found that compounds on the transition metals of Groups IV, V and VI, as well as some others, were active polymerization initiators when added to the aluminium alkyl, titanium giving particularly useful

ZIEGLER SYSTEMS

Catalyst, Groups I-III

Halides: CrCl_3 , TiCl_4 , WCl_6
 Oxyhalides: VOCl_3
 Alkoxides: $\text{Zr}(\text{OR})_4$
 Mixed alkyls/halides: TiR_2Cl_2

Co-catalyst, Groups IV-VIII

Alkyls: AlR_3 , NaR
 Hydrides: LiAlH_4
 Mixed alkyls/halides: AlR_2Cl
 Alkoxides: $\text{Al}(\text{CH}_3)_2(\text{OCH}_3)$

results. Ziegler's chief interest had been in polyethylene, but after he had disclosed details of his work, Natta was able to prepare and characterize the stereospecific polymers from other olefins, such as propylene and styrene. Natta found that with Ziegler-type catalysts it was advantageous to have the transition element in a valency less than its maximum, the α -form of titanium trichloride being a favourite of his. Reduction by the aluminium alkyl or hydride, which is also effective, undoubtedly takes place *in situ*, but Natta prepared his crystalline trichloride externally, and his systems are characterized by a solid phase to whose crystal structure he attributes great importance.

A typical system for the Ziegler-type catalysts consists of an aluminium alkyl, possibly the isopropyl or the isobutyl, with titanium tetrachloride, and I propose to use this as an example in the following discussions. A vast patent literature has grown up of the possible permutations and combinations and methods of preparation, but I shall ignore this in the interests of simplicity. There are a number of facts which it is worth noting at this point. Firstly, the components of a Ziegler system do not usually bring about polymerization by themselves, from which it seems a reasonable deduction that the actual catalyst is a complex of the two, though the composition of this complex is not easy to establish, since reduction of titanium to its lower valency states always takes place, and neither the product nor the catalyst is homogeneous in structure. In general, the aluminium alkyl promotes polymerization while the titanium controls the molecular weight. The proportions of the two components can be varied over a wide range to give different degrees of specificity in the product and differing reaction rates. It should be noted that a polymerization need not be entirely stereospecific and that the catalyst composition, which gives the most stereoregular product, is not necessarily that which gives the fastest reaction rate.

There is a great deal of art in the preparation of a Ziegler-type catalyst, if one can believe the patent

literature. The molar ratio of aluminium to titanium compound is generally about 1:1 to 1:2, depending on the product required. Thus with polyethylene the molecular weight falls as the titanium content increases, but the reaction rate goes up. The actual concentration used is, of course, important in industry, since the catalysts are rather expensive, and while this is closely guarded information it is probably less than one part of catalyst to 10,000 parts of monomer. There are many patents on the precise method of preparing the catalyst, e.g. do you mix the catalyst first and then add the other, and if so, which do you mix with the monomer? A typical catalyst preparation is to mix solutions of the catalyst components in, for example, a diesel oil and then to add the ethylene, but there are numerous variations on this theme.

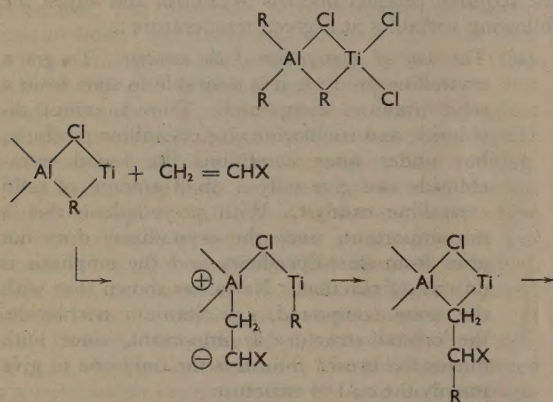
As I have stated above, Ziegler catalysts do not generally give a sterically pure compound and in general we get a mixture of the crystalline stereospecific product and the amorphous atactic polymer. In order to obtain the required product one has to control and adjust the following variables at a given temperature:

- (a) *The state of aggregation of the catalyst.* To get a crystalline product, it is desirable to start from a solid titanium compound. Thus titanium dichloride and trichloride give crystalline products, but under some conditions the liquid tetrachloride can give only a small amount of solid crystalline catalyst. With polyethylene this is not important, since the crystallinity does not arise from stereospecificity and the emphasis is on rate of reaction. Natta has shown that with the same compound, e.g. titanium trichloride, the crystal structure is important, since with dienes the brown β -form is the only one to give mainly the *cis*-1:4 structure.
- (b) *The degree of dispersion of the catalyst in the solvent, i.e. whether it is a suspended solid, a colloidal suspension or a true solution.* Catalysts with large particles tend to give crystalline products; finely dispersed ones tend to give amorphous polymers. If one prepares a given catalyst, it is possible to separate it into two parts by filtration, the solid residue giving a crystalline polymer, the filtrate a colloidal suspension and amorphous product. Some substituents, e.g. big alkyl groups, tend to give colloidal solutions rather than crystalline precipitants, and hence the alkyl group is important.
- (c) *The valency of the heavy metal.* The lower the valency, the more specific is the catalyst with, for example, zirconium, chromium and titanium.

The molecular weight is controlled by temperature and by the ratio of aluminium to titanium. Increasing the titanium:aluminium ratio will reduce the molecular weight, though this may be at the sacrifice of reaction

velocity, and chain transfer agents, *e.g.* hydrogen, have also been used. The reaction is generally carried out in the temperature range from atmospheric to about 100°C, and at pressures less than 100 atm. The problem is thus to find the conditions of catalyst preparation, composition and concentration, as well as gas pressure, which give the required molecular weight at an economic rate and acceptable catalyst consumption.

In discussing the mechanism of Ziegler reactions, it is well to bear in mind that since different systems give different degrees of tacticity and differing molecular-weight distributions there must be several mechanisms. It is well established that the titanium is reduced from the tetravalent to the tri- and even di-valent state, but the tri-chloride is not active in the absence of the aluminium compound. This indicates clearly that a complex catalyst is formed, and with AlR_3 and TiCl_3 it has been suggested that the active catalyst is of the type shown below. It should be noted that aluminium compounds are frequently associated.

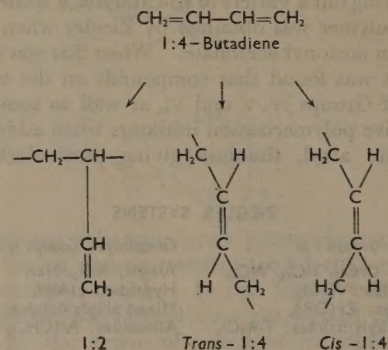


Reaction may then take place as indicated, since it has been shown that with an aromatic aluminium compound the polymer contains a phenyl group, but not when an aromatic titanium compound is used.

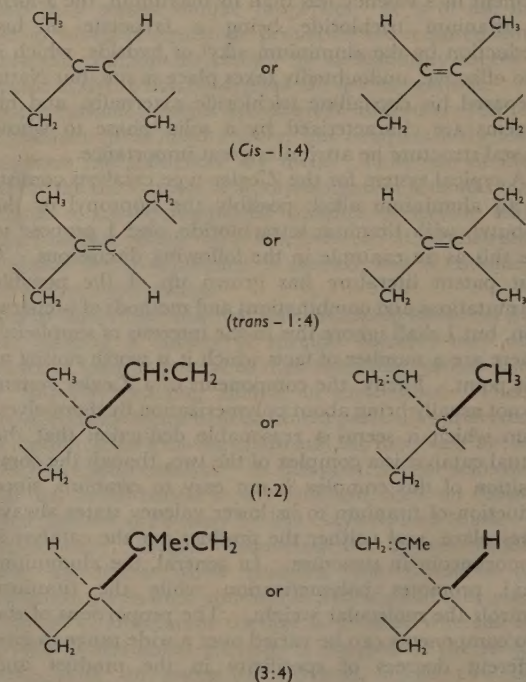
Before leaving polyethylene, reference must be made to the other commercial low-pressure process for producing polyethylene, namely the so-called Phillips process being operated in this country by the Distillers Co. This uses a chromium oxide catalyst deposited on an alumina-silica carrier, the polymer being formed in solution, so that it can be separated from the solid catalyst by centrifugation. The mechanism of the reaction is not clearly understood, but it appears important that the chromium is in an intermediate state of reduction. It is interesting that the type of unsaturation in the polymer is almost entirely terminal vinyl, whereas with Ziegler polymers the terminal vinyl and branched vinylidene are of the same order.

We now pass from the polymers of mono-olefins, which can exist in two stereoregular forms, to those of

the dienes, particularly the conjugated dienes, such as butadiene and isoprene. Here the situation is much



more complex in that there are geometrical isomers arising from the double bond in the polymer. Polybutadiene can exist in three forms, the 1:2- and the *cis*- and *trans*-1:4 forms. Taking isoprene, four types of structure are possible in the polymer, *i.e.* 1:2, 3:4, and *cis*- and *trans*-1:4. In addition each of these



structures can add to the preceding unit in two ways, and the 1:2 and 1:4 are stereospecific in the sense used above. These four groups, *i.e.* 1:2, 3:4, *cis*-1:4 and *trans*-1:4, can be identified from the infra-red spectrum of the polymer, and the composition of the mixture obtained is very sensitive to the type of catalyst.

Natural rubber is essentially *cis*-1:4-polyisoprene, and crystallizes on cooling or elongation.

The catalysts based on the alkali metals and their compounds are a particularly interesting and rather baffling group. The metal is generally in the form of a very fine dispersion, prepared by melting the metal in a saturated hydrocarbon, and dispersing by high-speed agitation.

If we polymerize butadiene we get the following results with the various metals themselves.

TABLE I
MICROSTRUCTURE OF ALKALI METAL-CATALYSED POLYMERS

Catalyst	Polyisoprenes			
	Per cent <i>cis</i> -1:4	Per cent <i>trans</i> -1:4	Per cent 3:4	Per cent 1:2
Lithium ..	93	0	7	0
Sodium ..	0	43	51	6
Potassium ..	0	52	40	8
Rubidium ..	5	47	39	8
Cesium ..	4	51	37	8

Catalyst	Polybutadienes		
	Per cent <i>cis</i> -1:4	Per cent <i>trans</i> -1:4	Per cent 1:2
Lithium	35	52	13
Sodium	10	25	65
Potassium	15	40	45
Rubidium	7	31	62
Cesium	6	35	59

It will be seen that the proportions with lithium are rather similar to the emulsion polymers and that as the alkali metal gets bigger the 1:2 form is progressively favoured at the expense of *cis*-1:4. However, with isoprene a different picture presents itself, the lithium giving almost exclusively the *cis*-1:4. It has been pointed out that monomer structure has a considerable effect, butadiene being mainly *trans*, while isoprene is largely *cis*. The Firestone Rubber Company have developed their so-called Coral Rubber with lithium to give a product almost identical with natural rubber, except that it contains a little more 3:4, again at the expense of *cis*-1:4. A very similar material, Ameripol, has been prepared by Goodrich-Gulf by a Ziegler-type catalyst of a specific titanium/aluminium ratio. It is stated that at titanium/aluminium = 2 the product is all *trans*-1:4-isoprene, but between 0.5 to 1 and 1.5 to 2 the product is *cis*-1:4.

Since we are carrying out an ionic reaction in a poorly ionizing medium, it is not surprising that small amounts of polar compounds have a major effect. The effect of small proportions of an ether, tetrahydrofuran, is interesting in that very small amounts will greatly modify the product distribution.

TABLE II
EFFECT OF SMALL PROPORTIONS OF TETRAHYDROFURAN ON STEREOSPECIFICITY OF LITHIUM CATALYSTS

THF (on heptane) per cent	1:4-Polyisoprene per cent
0	93
0.1	86
0.2	79
0.5	60
1.0	<i>ca</i> 30

As will be seen from Table III this represents what one might call the usual anionic pattern.

TABLE III
COMPOSITION OF POLYISOPRENES

Catalyst	Medium	<i>cis</i> - 1:4 per cent	<i>trans</i> - 1:4 per cent	1:2 per cent	3:4 per cent
Radical	Emulsion	22	65	6	7
Li, LiAlk	Hydrocarbon	93	0	0	7
Na, K	Hydrocarbon	0	50	10	40
Alfin	Hydrocarbon	27	52	5	16
Li	Ether	0	49	5	46
Na	Ether	0	33	12	55
Li, Na	Tetrahydrofuran	0	33	15	52

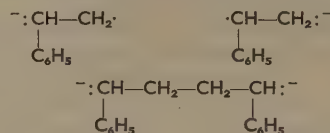
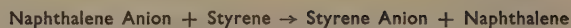
Lithium compounds and lithium metal are rather specific here in that in non-polar solvents they give very largely the *cis*-1:4-type. The only apparent difference between these two catalysts is a slow build-up of rate with the metal, which can be interpreted as due to the formation of lithium alkyl and this latter is then the effective catalyst. The origin of the difference noted between lithium and the other alkali metals is probably linked to the very small size of the lithium atom, and the highly polar nature of the Li-C link. Lithium methyl is salt-like, being soluble in ether but not in hydrocarbons, with which the higher alkyls are associated, but with a higher solubility in hydrocarbons. As always with stereospecific catalyst systems, one seems to be dealing either with a solid surface, or with substances that are associated and can be regarded as embryonic solids. The preponderance of the *cis*-1:4 product suggests that there is a cyclic transition state in the polymerization, but again it is not clear why lithium particularly shows this. It does, however, enable us to explain the effect of the ethers in termination or solvation, sterically or otherwise preventing the formation of a cyclic intermediate.

A similar change of configuration is reported with lithium fluorenyl and methyl methacrylate. At -60°C in a highly solvating solvent (dimethoxy methane) the product is syndiotactic, and similar to the free-radical product at the temperature, while with toluene a crystalline isotactic polymer is obtained.

Further interesting variants on these systems are the so-called Alfin catalysts which derive their name from the words alcohol and olefin. The catalyst is prepared by adding amyl chloride to sodium in pentane, which gives amyl sodium and sodium chloride. Isopropyl alcohol is then added to destroy at least half of the amyl sodium, and propylene is passed in to give allyl sodium. After that, it only remains to add the monomer. It has now become clear that the sodium chloride is as important as the other ingredients of the recipe in that it provides an acceptable solid surface on which reaction can take place. It has been shown that the state of sub-division of the alkali chloride, which need not be sodium chloride, is important and that finely-ground NaCl is less effective than the precipitated material. The interionic distance seems to be important, since if it is less than 2.1 Å (sodium chloride) or greater than 3.29 Å, reaction does not take place, and these distances are comparable with the C1-C4 distance in a *cis* hydrocarbon chain. It has therefore been suggested that this is only an anionic polymerization taking place on a solid surface where it is favoured by the ionic environment. The characteristics of this type of polymerization are the product distribution, the high reaction rate and the high molecular weight, in addition to considerable specificity. Thus, butadiene reacts about seventy times as fast as isoprene, and four times as fast as styrene, while 2,3-dimethyl butadiene is apparently not polymerized at all. Similarly, monomers with functional groups react at that group rather than at the double bond. The main drawbacks appear to be a certain lack of reproducibility, the precise method of preparation being very important, and also the very high molecular weight of the product, which makes it difficult to process. However, the polymers produced can be induced to crystallize and the polystyrene at least appears similar to the isotactic variety from Ziegler-type systems.

While interest has centred on the *cis*-1:4-polyisoprene, Russian workers have reported that, using the chromium oxide catalysts referred to above, exclusively *trans*-1:4 polymers were obtained from butadiene and isoprene.

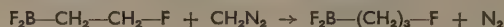
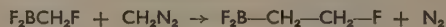
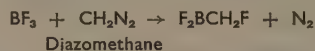
In conclusion let us consider one or two ways of making block copolymers. One method stems from the observation by Szwarc when polymerizing styrene with sodium naphthalenide, a green soluble complex, made by allowing sodium to react with naphthalene in tetrahydrofuran. In the absence of air or hydroxyl compounds there appeared almost no limit to the amount of styrene which could be polymerized by a given amount of metal. This was interpreted as being due to 'living polymers', *i.e.* very long-lived high-molecular-weight intermediates which did not terminate by combination. It has been shown that the initiation involves an electron transfer from the negative naphthalene ion to the monomer to give what can be regarded as an ion-radical. Monomer units can add at either end and eventually the radical ends will dimerize



like ordinary free radicals terminating to give a molecule with charged ends. Because of the separation and repulsion of like chain ends no termination occurs and propagation continues until all the monomer is consumed. Termination can be brought about by water, alcohol or any proton donor or oxygen, but in their absence a second monomer can be added which will all be used up, and if necessary a third. A characteristic feature of this system is that because of the absence of transfer and termination, the molecular-weight distribution is particularly sharp, though the product is not stereoregular.

A second method arises from the observation by Hoechst workers that whereas with Natta's catalyst (the violet TiCl_3 and AlEt_3) the molecular weight of the polymer was almost independent of time, temperature, monomer and catalyst concentration, catalysts could be developed which showed a marked dependence on all these things. They postulated long-lived radicals and were able to produce stereospecific block copolymers by passing in alternately ethylene and propylene to give products with properties intermediate in most respects between linear polyethylene and polypropylene, but quite different from those of a mixture. Chain-growth took place over hours and even days, and the reactions could be stopped and resumed by interrupting the addition of monomer. A recent publication has also given direct evidence for the existence of active centres with lives of some half an hour in a rather similar system. The experimental results, such as the different effects of interrupting the addition of monomer at different temperatures, are explained on the basis of a long growing time for the macromolecule and a temperature-dependent disproportionation reaction.

The last method which we shall consider is the use of boron trifluoride to polymerize aliphatic diazo-compounds. The mechanism has been closely studied by Bawn's school and they conclude that the steps are:



However long the chain is, its structure is similar to that of the initiating molecule and so should act as a catalyst for fresh diazo-compounds. By adding a different diazo-compound after the first has been used up a block copolymer can be made. There is, however, no evidence that these compounds are isotactic.

Book Reviews

MELLOR'S MODERN INORGANIC CHEMISTRY. Revised and edited by G. D. Parkes. Pp. xxii + 1024. London: Longmans, 1961. 40s.

This book is not one from which students of inorganic chemistry will learn the modern approach to the subject. When the book was first published in 1912 its content and arrangement of chapters no doubt justified its title, and the extensive use of the book by teachers and students in the years between the wars leaves no doubt that its arrangement represented the approach to the study of inorganic chemistry at that time. However, the years since 1940 have seen a complete change in the whole approach to the study of inorganic chemistry, but the reader would certainly not gather that impression by reading this book. The whole text, presentation and approach, is essentially that used in the old editions, and a textbook cannot be modernized merely by the use of a new flysheet and the addition, for example, of a scanty 15 pages on 'nuclear chemistry.' By re-issuing this book under the title of 'Modern Inorganic Chemistry' the publishers will inevitably foster displeasure amongst teachers and practising inorganic chemists, and they do a definite disservice to any students who may accept the book at its face value. It also continues the early practice of dealing first with general and physical chemistry. Of the total of 1,024 pages, the first 285 are concerned with such topics as the properties of gases, dilute solutions, electrolysis, thermochemistry, kinetics, colloids and so on. Such treatments must necessarily be cursory, and will not be attractive to students who already receive more complete instruction on these topics in other courses.

A few examples will substantiate this criticism. It is now generally accepted that the chemistry of the elements must be studied in the light of their electronic structure, *i.e.* with reference to their position in the long form of the Periodic Table, which separates the main groups and transition elements: this, however, is not done. The alkali metals are followed by copper, silver and gold and the alkaline earths by zinc, cadmium and mercury. The chapter on the boron group is followed by one of eight pages only which deals with the whole of the lanthanide and the transuranium elements. The latter are covered in two pages, which do not even begin to reflect the modern significance of these elements. Similarly, comments on elements of the titanium group are added at the end of the chapter on the carbon group, and zirconium is dismissed in half a page of small print. Iron, cobalt and nickel are treated together with the platinum metals as Group VIII of the Periodic Table. This approach, continuing throughout the book, is sufficient to refute any claim that the book is 'modern.'

The second principle which the book ignores is that the structures of many molecules and ions are now known,

and that structure, electronic configuration and reactivity are intimately related. Reference to the structure of inorganic substances is very limited in comparison to what is nowadays desirable. Where structure is mentioned, it is often misleading. Thus a structure for the oxide N_2O_5 is given (p. 469) without any reference to the ionic structure $NO_2^+NO_3^-$ in the solid.

The book therefore maintains the 'catalogue' approach which for generations has served to suppress interest in this branch of the subject. The 'less common' elements of the last generation have not emerged from this status, and much of the treatment of the better-known elements is obsolete. It is also doubtful whether the many diagrams of industrial apparatus serve any very useful purpose; the plant for the manufacture of bleaching powder (p. 548) even includes diagrams of the barrels in which the bleaching powder is collected.

The diagram showing $p-v$ curves for carbon dioxide (p. 45) is printed the wrong way up.

C. C. ADDISON

CHROMATOGRAPHIC AND ELECTROPHORETIC TECHNIQUES. SECOND EDITION. VOLUME I. CHROMATOGRAPHY. Pp. xvii + 617. 65s. VOLUME II. ZONE ELECTROPHORESIS. Pp. 215. 30s. Edited by I. Smith. London: William Heinemann, 1960.

The fact that the first edition of this work went through a first print and a reprint within 18 months of its appearance testifies to its popularity. In the second edition the aims are the same as before, to provide 'in concise form tried and tested methods and techniques.' Most of the material in the first edition, revised and with additions, appears in Volume I. Volume II is quite new. Both volumes have adequate indexes.

In Volume I there are general chapters on paper and column chromatographic apparatus and techniques, and on the chromatography of radioactive substances. The chromatography, usually on paper, of a wide variety of naturally-occurring substances, tranquillizers, barbiturates and other drugs and inorganic ions is dealt with in 20 chapters. Each has been written by acknowledged experts in the fields concerned, and each has an extensive list of references to recent reviews and original papers.

In a book such as this lengthy theoretical considerations would be out of place, but a little more information would have been helpful in deciding column sizes. In Chapter 4, column 'dead space volume' is defined but no indication is given of how this might be found, although its value is required for such practical matters as the volume in which substances are applied to the column or the volume of fractions collected during elution. As is usually the case with chapters contributed by different authors, there are a few contradictions which might have been avoided by more careful editing. For example, on page 18 it is stated that

'paper chromatographic separations relying on the use of monophasic solvents may generally not be realised on a column since cellulose in columns rarely behaves in a comparable manner to sheet paper' whereas on page 537 one reads, 'It is often found that columns of cellulose powder will allow separations similar to those obtained on paper sheets.'

A critical discussion of purification of paper for chromatograms by washing is missing.

Paper chromatography of steroids is often thought to be 'difficult' or at least 'different.' This may be due in part to the continued reference to the use of a 'hot box' (p. 421) for tanks. Such boxes are rarely used. A constant-temperature room is important for the best results in the chromatography of many substances but good results can be achieved if tanks are carefully screened from draughts and sunlight.

Methods for determining urinary steroids are given in some detail, but the reader should be warned that the column described for pregnanetriol (p. 444) will not give satisfactory results unless the activity of the alumina used is carefully adjusted. Methods of standardizing alumina columns are not mentioned in the book.

The sections dealing with the clinical applications and interpretations of amino acid and steroid chromatography are rather sketchy and would not normally be looked for in a book of this nature.

These criticisms are relatively unimportant when one considers the enormous amount of information condensed into the numerous tables and 'maps' of spots on paper chromatograms and the many useful 'tricks' described in the text. Indeed this very practical manual can be strongly recommended to all who practice chromatography.

Volume II has chapters dealing with low-voltage paper electrophoresis of proteins, lipoproteins, amino acids, nucleotides and haemoglobins, high-voltage and continuous paper electrophoresis, agar and starch-gel and block electrophoresis, cellulose-acetate electrophoresis and diffusion techniques. Again, these have been written by different workers experienced in the use of the techniques described. The use of a variety of commercially-available pieces of equipment is described, and there is considerable repetition of detail regarding application of solutions, use of buffers and location of bands on the paper.

The cellulose-acetate techniques might be singled out for the simplicity of the equipment involved and the excellence of the separations obtained. After electrophoresis, immuno diffusion and straining of the precipitation bands the strip can be rendered glass-transparent by oil, giving a beautiful permanent record.

In this Volume, too, all techniques are clearly described in detail, and each chapter has a good bibliography. It should be of great value to those wishing to apply electrophoretic techniques to their problems.

J. K. GRANT

COLLEGE CHEMISTRY. A SYSTEMATIC APPROACH. Second Edition. H. H. Sisler, C. A. VanderWerf and A. W. Davidson. Pp. x + 709. New York: The Macmillan Company; London: The Macmillan Company, New York, 1961. 44s.

In recent years a number of American textbooks on college chemistry have appeared in this country. Apparently they are designed to meet the requirements of university courses supplying a chemical background to students specializing in other fields. Of the many books of this type I have examined, this is one of the best.

The book attempts to cover a wide range of chemical knowledge from the laws of chemical combination to nuclear energy and rocket fuels, from elementary inorganic chemistry to biochemical processes and plastics. For this reason the treatment of some topics is rather more like that in a work of popular science than that in a serious textbook.

However, although a more rigorous approach to certain theoretical aspects and a more complete description of the chemistry of some elements may be considered desirable for the budding chemist, the superficialities and the wide coverage in this book are no doubt advantageous to the non-specialist.

Unlike some similar British textbooks, this one is very up to date both in its general approach and in its subject matter. The general pattern of the book is normal for its type. There are 16 physico-chemical chapters, mainly at the beginning, 20 chapters on inorganic chemistry, including the systematic chemistry of the elements, and three chapters on organic chemistry, biochemistry and plastics. There is even a chapter on 'Chemistry, Rockets and Outer Space.'

The development of the subject matter is logical, fresh and stimulating and, within the above-mentioned limitations, satisfactory. A very laudable feature is the emphasis which is at all times laid on the relation of physical and chemical properties to atomic and molecular structures, and on the use of the periodic table—features which are still, unfortunately, all too rare in courses at this level. Atomic and molecular orbitals and the Lowry-Brønsted and Lewis concepts are introduced and presented in a simple fashion. Problems and study questions—some of them extremely good—appear at the end of each chapter. The book is well produced, and illustrated with appropriate line diagrams and photographs.

As a student text in this country, this book will have a limited value. It could perhaps be recommended to non-specialist chemistry students such as biologists, engineers and so on, and to those studying for G.C.E. 'A' level. Ordinary National Certificate students are probably better served by existing books less comprehensive in nature. Teachers of chemistry should find this book useful, and it would no doubt be a valuable addition to the library shelves.

M. B. WATSON

ELECTRODE PROCESSES. Discussions of the Faraday Society. No. 1, 1947. Pp. 338. *London: Butterworths*, 1961. 60s.

The publishers have performed a service to electrochemists in reprinting this volume, which has long been out of print. It was the first of the Faraday Society Discussions to be separately issued, starting a series the value of which it would be difficult to over-emphasize. It marked the entry of what may be called 'Electrode Chemistry' into a phase of rapid development. The author index contains over 60 distinguished names of contributors to the discussion, under the headings general and theoretical, hydrogen overvoltage, deposition of metals, oxygen overvoltage, anodic processes and cell reactions in general. All of the original, informal discussions are reproduced, and remain interesting, stimulating and refreshing to read.

It may well be that the re-publication of symposia of this kind, still in demand after more than a decade, will become an essential service for the purpose of providing starting points for thinking, or re-thinking, about unsolved, or partially solved, problems and for the revival of ideas not properly appreciated at the time.

The volume is well produced and should find a place in all electrochemists' libraries.

D. J. G. IVES

COBALT: ITS CHEMISTRY, METALLURGY AND USES. A.C.S. Monograph No. 149. Edited by R. S. Young. Pp. vii + 424. *New York: Reinhold Publishing Corporation; London: Chapman & Hall Ltd*, 1961. 120s.

This excellent book is edited by a well-known chemical engineer assisted by a panel of seven specialists. It supersedes the earlier monograph No. 108 entitled simply 'Cobalt,' and the many changes reflect both increases in knowledge and the rather changed attitude towards research which has almost effaced the very arbitrary distinctions formerly made between pure and applied science.

Successive chapters deal with the history (10 pp.) and occurrence of cobalt (25 pp.), its extractive metallurgy (28 pp.) and chemical and physical properties (10 pp.). An account of simple compounds of cobalt (14 pp.) is followed by an absolutely first-rate and thoroughly up-to-date account of its co-ordination chemistry (69 pp.) which does great credit to its author, Dr Busch. Phase diagrams for cobalt (27 pp.), magnetic, electrical and electronic applications (29 pp.), and cobalt alloys for high-temperature and high-strength service (38 pp.) are also treated by specialist authors. Tool steels and other metallurgical applications (10 pp.), cemented carbides (10 pp.), electroplating cobalt (12 pp.) and the use of cobalt compounds in the glass and ceramic industries (10 pp.) each form the subject of thorough and well-balanced chapters which lead on to three important topics, *viz.* the catalytic behaviour of cobalt

(23 pp.), its applications in biology and medicine (31 pp.) and aspects of radioactive cobalt (25 pp.). The last chapter deals with analysis (27 pp.) and the book concludes with an author and a subject index. Each chapter concludes with well-chosen references arranged alphabetically, and comprising 1,444 entries in all.

In so vast an undertaking there will inevitably be points which individual readers will subject to special scrutiny and criticism. I have already marked out the chapter on co-ordination chemistry for special commendation. Minor disappointments were the lack, in Chapter 15, of a structural formula for vitamin B₁₂, and the incorrect structure of cobalt carbonyl hydride (p. 305). In the chapter on analysis, activation analysis is not discussed although it is mentioned (in a single sentence) elsewhere. Schwarzenbach's name does not appear among references to the complexometric determination of cobalt, nor is Sandell's monograph referred to in the account of its absorptiometric determination.

This is a very well produced book, and not dear by present standards.

H. IRVING

THE THIRD LAW OF THERMODYNAMICS. J. Wilks. Pp. viii + 142. *Oxford: University Press*, 1961. 15s.

In this small book the author gives a concise and unified account of the history and the essence of the Third Law. The meaning of the different formulations is brought out clearly. It is shown which formulations are equivalent, and that the last one by Simon, which the author adopts, is more far reaching and goes beyond previous formulations. Among the wide field of applications admirably covered none is more striking than the phase separation of ⁴He/³He mixtures.

The chapters deal with entropy and probability; entropy and internal degrees of freedom; the Third Law of thermodynamics; the Third Law and internal degrees of freedom; the statistics of a perfect gas; the statistical basis of the Third Law; nuclei and entropy; chemical equilibria; and the unattainability of absolute zero.

The treatment of statistical mechanics is excellent, with extensive reference to literature. The references and author index ought to receive special praise. Sometimes the choice as to which subjects are treated in some detail and which are merely mentioned with a reference to the original literature seems somewhat arbitrary. The Bose-Einstein gas, for instance, is treated in detail while the Fermi-Dirac gas is not. Such unevenness may, however, be unavoidable in a small monograph.

As the book is to be read by undergraduates, I should like to point out instances of insufficient definition: on page 20, 'The Entropy of a perfect gas' when the entropy of a *monatomic* perfect gas is meant; on page 21, 'Using the equation of state for a perfect gas and the usual

expression for C the word monatomic is again left out; on page 26, 'The entropy of a perfect gas arises solely from the translational motion of the molecules. In real gases there may be contributions from rotation etc.'—this is not true, as there are polyatomic *perfect* gases; and on page 29, when deriving the entropy of mixing, the author does not explicitly state $N' + N'' = N$ (Avogadro's number), i.e. that we deal with a total of one mole. These are, of course, very minor criticisms of an excellent book which, it is to be hoped, will be widely read by all students of physical chemistry.

O. E. FORD

COMPREHENSIVE ANALYTICAL CHEMISTRY.
VOLUME IB. CLASSICAL ANALYSIS. Edited
by C. L. Wilson and D. W. Wilson. Pp. xxii +
878. Amsterdam: Elsevier Publishing Co.; London:
D. Van Nostrand Co. Ltd, 1961. 155s.

This is the second of the three parts that are to make up Volume I, Classical Analysis, of *Comprehensive Analytical Chemistry*. Although there are 300 pages more than in Volume IA they comprise but two chapters, 'Inorganic Titrimetric Analysis' and 'Organic Quantitative Analysis.'

Chapter VII, following an introduction by C. L. Wilson, is made up of 10 sections: theory and principles; apparatus, acidimetry and alkalimetry; argentometric methods; potassium permanganate, potassium dichromate and ceric sulphate; iodine, sodium thiosulphate arsenious oxide, ferrous and mercurous; potassium bromate, potassium iodate and sodium hypochlorite; titrations with EDTA and related compounds; and miscellaneous reagents.

Chapter VIII is introduced by Dr Alison Macdonald, and there follow sections on treatment and weighing of samples; determination of elements; determination of functional groups; titrations in non-aqueous solvents.

As in Volume IA the various sections have been contributed by a number of experts, 16 in all, and in these circumstances some unevenness of presentation is not unexpected. It is nevertheless something of a shock to pass straight from the erudite section on theory and principles to a section on apparatus in which burettes, pipettes, measuring cylinders and beakers are described and illustrated. It must, of course, be difficult to know what constitutes 'Comprehensive Analytical Chemistry' but the magnitude of the task undertaken by the authors and the time scale and objectives announced by the publishers should in themselves set some boundaries.

By far the best and most comprehensive part of this book is the chapter on quantitative organic analysis. Both the standard procedures and the specialized modifications are adequately treated and, with the exception of the section on treatment and weighing of samples, are well illustrated. In her introduction to this part of the book, Dr Macdonald suggests, quite properly, that 'current trends in organic analysis lead to

the speculation that, in some years time, analyses will be carried out with massive instruments on virtually invisible samples.' When, however, she goes on to ask 'whether much will be gained by replacing a trained analyst by a trained electrician' she not only confuses the issue by an unfortunate choice of terms but seems to the reviewer to denigrate the real and potential advances in 'analytical chemistry' which have been made possible by cross-fertilization with other disciplines. It is as true of organic analysis as of any other branch of analysis that a determination of the elements by chemical methods does not necessarily constitute the whole of analysis. The editors faced up to these problems quite fairly in their excellent introduction to the series and we shall no doubt learn in the subsequent volumes of techniques by means of which classical procedures have been improved, extended or replaced.

Volume IB of this enterprise, like IA, can be recommended to all who are concerned with analysis, although it must be admitted that the section on organic analysis is likely to prove the more useful part of the book.

The presentation is good, the references up to date and the binding excellent, an important matter in so large a book. The price seems high but for a book of this character and size it is perhaps not unreasonable.

R. C. CHIRNSIDE

QUALITATIVE ORGANIC ANALYSIS. B. Haynes.
Pp. 239. London: Cleaver-Hume Press Ltd, 1961.
17s. 6d.

This book follows closely on the heels of another recent publication on qualitative organic analysis reviewed in this *Journal* (J., 176). Both emanate from technical colleges in the same area and are intended for the same type of student.

At first sight the two publications appear to be very different. This one is much larger in external size and costs almost three times as much as the other. However, when the contents are examined the differences are nothing like so marked, except for the melting point tables. The tables here are very extensive and quite adequate for normal purposes. They occupy almost exactly one third of the total number of pages in this case, whereas they are very sparse in the earlier book. In other subject matter the actual contents are not widely different, as it is in size of print and spacings that the differences occur. Both books adopt the same general approach of an extensive preliminary examination designed to reduce the amount of classification required thereafter.

Taking this book on its own, one is immediately struck by the unusual binding. The plastic spiral produces a book which will remain open and flat at any page, and this is an obvious advantage in any laboratory manual. Doubts may arise as to its durability, but presumably the publisher has satisfied himself on that

aspect. Photolithographic printing, while reducing costs, appears to have imposed rather severe limitations on the variety of print and spacings used, and the impression given is very similar to that of a musical work rendered throughout *mezzo forte*. Headings would benefit from more emphasis, and the layout would be improved by using less space within a particular test and more space between tests.

These criticisms of the presentation of the material must not be allowed to detract from the quality of the material itself. In fact, little criticism needs to be made in that direction. The author obviously speaks from experience and presents his well-tried scheme, inserting cautionary remarks in many tests and about various commercial reagents, such as zinc dust and dioxan. The references (pp. 33, 131 and 229) to four papers published within the last 10 years are indicative of a progressive attitude. The book covers the needs for Grad.R.I.C. and degree courses and can be recommended on its contents.

D. A. BAYLES

DEUTSCHE EINHEITSVERFAHREN ZUR WASSER-, ABWASSER- UND SCHLAMMUNTERSUCHUNG. Third Edition. Second Number. Fachgruppe Wasserchemie in der Gesellschaft Deutscher Chemiker. Weinheim: Verlag Chemie GmbH, 1961. Parts I and II, DM 27.50.

This is a further instalment of methods for determining the chemical and bacteriological constituents of water, effluents and sludge. The presentation of the methods is by the loose-leaf system, and it is intended that the sheets should be incorporated in the binder mentioned in the previous review (*J.* 1960, 394).

The most important section (29 pp.) is that devoted to bacteriological methods: the sterilization of apparatus, the collection and transport of samples, and the preparation of culture media. The usual British methods are adopted, and *E. Coli* is differentiated from *Aerogenes* by the indol, methyl red, Voges-Proskauer and citrate tests. Membrane filtration and enumeration are also described.

The chemical section devoted to biochemical oxygen demand comprises some 14 pages, and a two-day period of incubation as well as the more usual five-day period is advocated. A synthetic dilution water is recommended. Nitrate is determined colorimetrically with sodium salicylate, or by reduction with Devarda alloy and titration of the ammonia formed. A method given for nitrite depends on the formation of nitrosoindol.

The determinations of ammonia, oxygen demand by permanganate and by dichromate, and organic nitrogen by the Kjeldahl process all follow the usual pattern.

Finally, there is an excellent section of nine pages devoted to detergents; anionic detergents are estimated by the methylene-blue method, or by titration of the relatively insoluble *p*-toluidine anion complex. Tetra-

propylene benzene sulphonate is the standard used. The coloured complex formed by adding bromophenol blue to a cationic substance is used to estimate such detergents, cetyl-trimethyl-ammonium bromide being the standard used.

W. G. CAREY

NUMERICAL METHODS OF CURVE FITTING. P. G. Guest. Pp. xiv + 422. Cambridge University Press, 1961. 80s.

Whilst it is true to state that a book written in a fundamental and interesting manner can be profitably employed by any class of user, in the case of this book the chemist might well note that it is primarily written for students and graduates of physics. These scientists will, in most teaching establishments, have undergone a course of advanced mathematics and statistics so that the elementary basis of the subject has been made clear to them. Unfortunately, this training is not usually to be found in the average chemist's course of study and, as a consequence, he will find this book to be far too advanced in its claim to provide an introduction to methods of treating series of observations. A thorough preliminary study of more elementary texts is to be recommended for such a reader.

To the chemist with an appreciable mathematical background, or the chemist who has had some statistical experience, this book may well be of considerable use. Its approach is somewhat unorthodox in that it attempts, with reasonable success, to present material which, up to the present, has been found only in original literature. Both derivation and application of the statistical methods are given. Although the information has been put together in a fairly continuous manner, this approach has caused the omission of much of the simpler statistics which any chemical statistician usually finds applicable to his work. The three parts cover observations of a single variable (very briefly), the fitting of data to straight lines and the fitting of polynomial curves, respectively. Whereas Part I can be regarded as a small appendix to standard works on the subject, the contents of Parts II and, particularly, III can be regarded as useful and meaty supplements.

Three aspects of the book are particularly pleasing: the table of contents is very full and clear (in common with most statistical textbooks); secondly, most chapters are introduced with a summary of aims of the material which follows; and thirdly, the text is liberally seeded with numerical examples which are amplified with the calculating techniques.

A beginner to statistics will be ill-advised to consult this book as a first step in solving a problem, but the chemist with training in statistics will find the volume a useful supplement to the established works in this field. In that respect, its use will primarily be as a reference work rather than a fully-developed and complete textbook.

D. A. PANTONY

Institute Affairs

SPECIAL GENERAL MEETING

20 July, 1961

A Special General Meeting of the Institute was held in the Large Lecture Theatre, The School of Pharmacy, Brunswick Square, London, W.C.1, on Thursday, 20 July, 1961, at 6 p.m. Sir William Slater, K.B.E., F.R.S., *President*, was in the Chair, and 97 corporate members signed the record of attendance.

THE SECRETARY (Dr H. J. T. Ellingham) read the notice convening the Meeting.

With the unanimous approval of those present, the Chairman appointed Mr W. H. Bennett and Mr P. F. Corbett to act as Tellers in respect of the voting on the three resolutions to be submitted at the Meeting.

RESOLUTION No. 1

CHANGES IN THE BY-LAWS OF THE INSTITUTE

THE CHAIRMAN drew attention to the fact that the purpose of the resolution was to effect changes in the By-laws of the Institute, and that it would be passed only if at least two-thirds of the members voting in person or by proxy voted in favour of the proposals. He also suggested that, in view of the length of the resolution, it would be helpful to dispense with the formality of reading it in full when formally proposing its adoption. It was unanimously agreed that Resolution No. 1, as set forth in the notice convening the Meeting, be taken as read.

Note: Copies of the notice of the Meeting were sent to all corporate members in Great Britain and Ireland. Resolution No. 1 is therefore not reprinted here. A further copy of the notice will be sent to any member on request.

THE CHAIRMAN, in proposing the resolution, briefly summarized the events that had led to its presentation, and explained that the proposed changes in the By-laws would provide the constitutional framework for the establishment of a Licentiate grade of membership on the basis of the terms and conditions set forth in the Memorandum that had been circulated to all corporate members in December, 1960, in connection with a Referendum on the proposal to introduce the new grade.

He drew attention to the statement by the Council that had been circulated with the notice of the Meeting and which reiterated earlier assurances that it was the intention of the Council, if the new By-laws were approved and subsequently allowed by the Privy Council, to ensure that the conditions of admission to Licentiate-ship would be such as to provide that Licentiates should be recognized as qualified scientists or technologists (as distinct from technicians) but at a lower academic level than the good honours degree equivalence that is required for admission to Graduate Membership or Associateship.

The proposed changes in the By-laws were concerned solely with the status, privileges and obligations of Licentiates. Except for the basic requirements relating to nationality, they did not refer to the conditions of admission of Licentiates and, if the resolution were passed, it would be for the Council to draw up detailed Regulations prescribing such conditions of admission.

There could be no doubt as to the outcome of the Referendum. More than 7,000 members had participated and a very substantial majority had indicated their support for the proposals. The Council had thus been given a clear mandate to take such steps as were necessary to implement them.

PROFESSOR N. R. DHAR seconded the resolution and the Chairman then invited discussion.

MR M. CLARKE said that he was in favour of the introduction of the proposed new grade of membership, but was not convinced that the term 'Licentiate' was the best choice, and he believed that other members had similar views. There appeared to be some confusion as to the precise significance of the term, and some other societies used it to denote grades that were different in status from that which the Institute might introduce. He was not able to suggest an obvious alternative but, if it were not too late, he hoped that other members might offer suggestions.

MR P. E. L. FARINA questioned whether it would be advisable to retain the category of Graduate Membership if the Licentiate-ship grade were eventually established. Too many grades would tend to cause confusion, and might thus lower the prestige of the Institute's qualifications. It might be simpler if those who had suitable qualifications were required to wait for the period necessary for them to gain the requisite approved experience and then be invited to apply for direct election as Associates.

MR E. J. VAUGHAN (Chairman of the Study Group on Qualifications) stated that almost every conceivable designation for the proposed new grade had been considered by the Council and its committees during the past two years. It had been realized that there were some objections to the use of 'Licentiate' but all the alternatives that had been put forward were open to more serious objection, and it had ultimately been agreed that the term 'Licentiate' was the most appropriate. With regard to Graduate Membership, he could not see that the retention of this grade would cause confusion, and he thought it would be very unfortunate if chemists with the appropriate qualifications should be denied the right to join the Institute simply because they could not be immediately admitted into a corporate grade.

MISS J. R. SCOTT referred to the provisions of the By-laws with regard to the nationality of corporate and non-corporate members and asked what would be the

position of South Africans when they were no longer Commonwealth citizens.

THE SECRETARY said that under the British Nationality Act, 1948, a person who is a citizen of South Africa is by virtue of that citizenship a British subject or a Commonwealth citizen. The departure of South Africa from the Commonwealth on 31 May, 1961, did not of itself alter this position, and it was expected that it would continue for 12 months after that date. The Council would therefore have an opportunity of considering the possibility of submitting a resolution at the next Annual General Meeting of the Institute under the provisions of By-laws 43 and 49. Unless such a resolution were submitted and approved, South Africans would cease to be eligible for admission to membership of the Institute when they ceased to be British subjects or Commonwealth citizens. The position of those who were already members would not be affected.

In reply to a question from Mr D. M. FREELAND it was confirmed that Graduate Members who had completed a prescribed period of approved experience before their admission to that grade required only one further year of satisfactory experience before they became eligible to proceed to the Associateship.

There being no further questions or observations, the resolution was formally put to the meeting. A vote was taken by show of hands: 94 members voted in favour of the resolution; 3 members voted against.

A count was then demanded under the provisions of By-law 10 in order that the votes of members who had appointed proxies might be taken into account.

The Tellers reported voting as follows:

For the resolution 2,804 (94 present and 2,710 by proxy).

Against 243 (3 present and 240 by proxy).

THE CHAIRMAN accordingly declared the resolution carried by the requisite majority.

RESOLUTION No. 2

ANNUAL SUBSCRIPTION TO BE PAYABLE BY A LICENTIATE

THE CHAIRMAN proposed:

That this Special General Meeting of the Institute hereby accepts the recommendation of the Council that the annual subscription of a Licentiate shall be the sum of three guineas (£3 3s. 0d.) and resolves that such annual subscription shall be paid by each Licentiate until otherwise determined by resolution at a General Meeting of the Institute.

PROFESSOR N. R. DHAR seconded the resolution.

Questions and comments were invited but no members wished to speak. A vote by show of hands was then taken, and the resolution was passed without dissent. No count was demanded.

Note: The Chairman held 2,708 directed or discretionary proxies which, in the event of a count, he would have cast in favour of the resolution. He also held 195 proxy votes to be cast against the resolution. Proxies given to other members were as follows: to be cast for the resolution 40; against 1; discretionary 9.

RESOLUTION No. 3

EXTENSION OF THE BENEVOLENT FUND'S OBJECT

THE CHAIRMAN proposed:

That this Special General Meeting of the Institute hereby authorizes and requests the Council of the Institute, upon allowance by the Lords of Her Majesty's Most Honourable Privy Council of the variations in the By-laws set forth in the resolution No. 1 submitted to this Meeting, to take such steps as may be requisite for enabling the Benevolent Fund of the Institute to be used for the benefit of those who are or who have been Licentiates of the Institute, their wives, children, widows and dependent relatives, and also the children, widows and dependent relatives of deceased Graduate Members in addition to the beneficiaries now specified in its Object.

Attention was drawn to the statement by the Council commending this proposal which had been circulated with the notice of the Meeting. The Object of the Fund, as at present constituted, referred only to Fellows and Associates and their dependants. As it was proposed that Licentiates should be corporate members, it seemed desirable that the Object of the Fund should be extended in order that they and their dependants might also be eligible for assistance. On the other hand, Graduate Members were not corporate members, and the Council had concluded provisionally that they should not be eligible for assistance, especially as they were in a transitional grade and could be expected to proceed to Associateship in due course. However, if a Graduate Member should die before he was in a position to apply for election as an Associate, it might be desirable to have the power to assist his dependants, and provisions to meet this contingency were therefore envisaged. An alteration in the Object of the Fund might give rise to legal difficulties, and the resolution was being submitted in order to obtain a preliminary indication of the wishes of members so that the Council might take appropriate action with a view to presenting a definitive proposal to a General Meeting at a later date.

MR E. J. VAUGHAN seconded the resolution and the Chairman invited discussion thereon.

MR W. HANCOCK expressed concern about the omission of Graduate Members and felt that it might lead to a few cases of very severe hardship. A Graduate Member might suffer a serious illness or accident and, if it were possible to assist the widows or children of deceased Graduate Members, it would be very unfortunate if there were no possibility of helping a living Graduate Member even in exceptional circumstances.

THE HONORARY TREASURER (Professor H. Burton) pointed out that, hitherto, Graduate Members had not been invited to subscribe to the Fund. There was no reason why they should not be asked to do so and it could certainly be argued that they should be eligible for assistance. The Council had taken the view that participation in the Fund should be linked with corporate membership, especially as the legal difficulties in the way of an extension of the Object of the Fund appeared to be in direct proportion to the magnitude of any such extension.

Other members, including Dr E. C. Wood, Mr P. A. Raine and Mr F. C. Hymas expressed doubts as to the wisdom of excluding Graduate Members.

THE CHAIRMAN gave an undertaking that the Council would reconsider the position of Graduate Members in the light of the observations that had been put forward, and again stressed that, if members gave their approval, in principle, to an extension in the Objects of the Fund on the general lines indicated in the resolution, detailed proposals would be submitted to a General Meeting in due course.

The resolution was then formally put to the meeting. On a vote by show of hands an overwhelming majority of members voted in favour of the resolution. The Chairman accordingly *declared the resolution carried*. No count was demanded.

Note: The Chairman held 2,732 directed or discretionary proxies which, in the event of a count, he would have cast in favour of the resolution. He also held 170 proxy votes to be cast against the resolution. Proxies given to other members were as follows: for the resolution 35; against 2; discretionary 13.

On behalf of those present, the Chairman expressed thanks to the authorities of the School of Pharmacy for the use of the Lecture Theatre. The proceedings then terminated.

EXAMINATIONS, JANUARY, 1962

Graduate Membership, Part I.—An examination will be held on Monday and Tuesday, 8 and 9 January, 1962, in London, and elsewhere at the discretion of the Council.

Candidates who have not yet been accepted for examination should obtain from the Assistant Registrar without delay the prescribed Application Form so as to allow ample time to secure thereon the necessary signatures certifying their courses of training. **The completed Application Form must reach the Institute not later than Monday, 9 October, 1961.** No application in respect of the January examination will be accepted if received after that date.

Entry forms will be sent as soon as they are ready to accepted candidates. **The last date for the return of Entry Forms will be Wednesday, 8 November,**

1961. No entry will be accepted if received after that date.

Graduate Membership, Part II.—The theoretical section of the examination—Part II(a)—will be held in London, and if required, in other centres, on Monday and Tuesday, 8 and 9 January, 1962.

The practical section of the examination—Part II(b)—will be held in London on Wednesday to Saturday, 10 to 13 January inclusive, and Tuesday to Friday, 16 to 19 January, 1962, inclusive.

Candidates will be asked to state their preference as to the centre for their theoretical papers, and the period for their practical examination, but it must be clearly understood that no guarantee can be given that their wishes will be met.

Last dates for application and for entry are the same as for the Graduate Membership Part I examination (*see above*).

EXAMINATIONS, JUNE, 1961

Graduate Membership, Part I

Examiners: Professor C. C. Addison, Professor C. W. Davies, Professor W. J. Hickinbottom

The examination was held at Chelsea College of Science and Technology, London, and at various local centres in the period 19 to 20 June, 1961.

The total number of candidates was 426, of whom 187 passed (44 per cent).

Of the 426 candidates, 35 had taken full-time courses, of whom 16 passed (45.7 per cent); 13 of the 28 who attended sandwich courses passed (46 per cent); 33 attended part-time courses preceded or followed by a period of full-time study, and 21 passed (63.6 per cent). Of the 330 who received their training entirely by part-time courses, 136 were successful (41 per cent).

Graduate Membership, Part II Special Relationship Scheme

Assessors: Professor W. G. Overend, Dr A. G. Sharpe, Professor W. F. K. Wynne-Jones

The examination was held in each of the five Colleges in Special Relationship with the Institute in June, 1961. Each college set its own examination papers, which were moderated by the Institute's Assessors, who also acted as external examiners in respect of the marked scripts.

There were 158 candidates, of whom 85 passed (53.8 per cent).

Of the 158 candidates, 88 had previously passed Part I of the Graduate Membership examination, and of these 41 passed Part II; 41 candidates had been exempted from Part I under the provisions of Regulation F3, of whom 28 passed Part II; seven candidates had been exempted from Part I under Regulation F4, of whom three passed Part II. Of the 22 candidates who had not passed any of these 'hurdles,' 13 were successful.

PASS LIST: PART II

Birmingham College of Advanced Technology

GLOVER, Trevor John TIGHE, Brian John
 LLOYD, John Brian Ford

Bristol College of Science and Technology

BOWLER, David Charlton HALFYARD, Peter
 CHAMBERLAIN, Brian Raymond
 Richard MILLS, David
 COTTRELL, David Walter POPE, John Richard
 GERRISH, Barrie Crandon SALTER, Brian George
 Beresford SUTTON, Anthony Hubert
 TALL, Peter David

Kingston-upon-Hull College of Technology

BENTLEY, Michael GREENSIDES, Barry George
 COATES, Peter HAWKINS, Peter
 COCKERILL, Peter Edward LITTEN, John Atkinson
 CROWE, Alan READHEAD, Michael John
 GOWLAND, Michael Colin STOUT, Eric George

Liverpool College of Technology

ABRAMSON, Solly Bernard HOLDING, Michael Edward
 BEESLEY, James MALTPRESS, Alan John
 BOOTHBY, Leonard, MEARNES, Ronald David
 B.SC.(DURH.) MOSS, Leslie
 BOYLE, Ian Wilson PATON, Gilbert Owen
 BUTLIN, Roy Norman PLEWS, Ronald Wesley
 CLIFFE, Francis Jeffrey POSTLETHWAITE, Brian
 CLUGAS, Alexander REGAN, George William
 William RIDDOCH, John
 COLLINS, Robert John SHARP, Peter Frank,
 DIXON, Michael Trevor B.SC.(LIV.)
 ECCLES, John SYKES, Bryan
 FERNLEY, Arnold Michael WHITEHEAD, Norman
 GOODALL, David
 Raymond, B.SC.(LIV.)

Royal College of Advanced Technology, Salford

BAINE, Peter HUNTER, Geoffrey
 BREAKSPERE, Robert JACKSON, Anthony
 James JONES, Barry David
 CALDWELL, David JONES, Neville Arthur
 CARTER, Brian Howell LANSDALE, Brian Spencer
 CLARKE, Alan Reginald LEEMING, Peter Alfred
 CONNOR, William Anthony LEWIS, Cyril John
 EDWARDS, William LOWDEN, George Alan
 Howard MILLINGTON, James Peter
 FENTON, Francis MORRIS, Gordon Leonard
 GREEN, William REED, Sydney George
 GRUNDY, George Alan SHEPHERD, Malcolm
 HAMMOND, Miss Barbara David
 Helen SLOANE, Francis Clifford
 HUBAND, Eric Reginald SMITHIES, Barry
 HUGHES, Jeffrey SUTTON, Alan Hugh

TAYLOR, Edward Nicholas WOLSTENHOLME, Walter
 TONGE, Kenneth Hodgson Alan
 TURNER, Leslie WOOD, Allen
 WALLER, Brian Ernest WOODWARD, Antony Ian
 WELSBY, Gerald WRIGHT, John
 YOUNG, Thomas

British Standards Institution.—Dr J. W. Smith has been nominated to represent the Institute as well as the Chemical Society on Technical Committee C/34—pH Scale, in succession to the late Professor H. T. S. Britton, who also represented both bodies on this Committee.

Technical Committee CHE/36—Chemicals and Chemical Plant for Electroplating has been transferred as SRE/8 under a new Industry Standards Committee to be known as 'Surface Coatings (other than Paints) Industry Standards Committee SRE/—.' Professor L. Aitchison, who represented the Institute on CHE/36, has accepted an invitation to become the representative on SRE/8.

Mr C. H. Wood has agreed to represent the Institute on a new Technical Committee CIC/20—Sulphur, Hydrochloric and Sulphuric Acids that has replaced Sub-Committee CIC/6/1, on which he previously served.

The President, on behalf of the Council, has nominated Mr. A. N. Adamson to represent the Institute on Technical Committee CIC/24—Alumina. This Committee has been set up to look after U.K. interests in the preparation of recommended methods of test for alumina to be considered by a new Working Group of the International Organization for Standardization.

PERSONAL NOTES

Honours and Awards

Dr B. E. Conway, *Fellow*, Professor of Chemistry in the University of Ottawa, has been awarded the degree of D.Sc. by the University of London for his research contributions in the field of electrochemistry of reactions at electrodes and in electrolyte solutions.

Dr D. A. Hall, *Fellow*, divisional chief scientist, National Coal Board, Durham Division, had the degree of D.Sc. of the University of Bristol conferred on him at a congregation on 5 July. The degree was awarded for a submission based on published work, mainly concerned with the preparation and utilization of coal. Some inorganic research work dealing with the rare-earth elements was also included.

Mr M. M. Heywood, *Fellow*, director of P. B. Cow & Co. Ltd, has been awarded the Hancock Medal of the Institution of the Rubber Industry for his outstanding services to the Institution and the rubber industry.

Dr C. N. Ramachandra Rao, *Associate*, of the department of physical chemistry, Indian Institute of Science, Bangalore, has been awarded the degree of D.Sc. by the University of Mysore for his thesis entitled 'Studies in Nitrogen Chemistry and Structural Chemistry'.

Institution of Chemical Engineers.—Sir Harold Hartley, G.C.V.O., C.B.E., M.C., F.R.S., *Honorary Fellow*, Mr H. W. Cremer, C.B.E., *Fellow*, and Professor M. B. Donald, *Fellow*, have been elected to honorary membership of the Institution in the class of Corporate Members, in recognition of their long and distinguished service to the Institution.

Educational

Mr D. Abson, *Associate*, has taken up a postgraduate research appointment in the department of chemistry, University of British Columbia, Vancouver, Canada.

Mr V. A. A. Archer, *Fellow*, formerly laboratory supervisor of the Public Health Laboratory, Barbados, has been appointed resident tutor in the department of extra-mural studies, University College of the West Indies, Barbados.

Dr B. E. Betts, *Associate*, an assistant lecturer at the Polytechnic, Regent Street, London, has been given a year's leave of absence to take up a postdoctoral research associateship at the University of Illinois.

Dr C. J. Brackenridge, *Associate*, formerly senior chemist, biochemistry department, Royal Perth Hospital, Western Australia, is now at the department of biochemistry, University of Florida School of Medicine, U.S.A.

Dr F. A. Filby, *Fellow*, has been appointed senior lecturer in inorganic chemistry, South-East Essex Technical College, as from 1 September.

Dr Rachel H. Gourlay, *Associate*, has accepted a postdoctoral fellowship for one year at the University of Rochester, Rochester, N.Y., U.S.A.

Dr T. Green, *Associate*, has been appointed senior lecturer in chemistry, Mid-Essex Technical College and School of Art, as from 1 September.

Dr N. N. Greenwood, *Fellow*, formerly senior lecturer, department of chemistry, University of Nottingham, has been appointed to the Chair of Inorganic Chemistry, King's College, Newcastle upon Tyne.

Dr D. W. Hutchinson, *Associate*, formerly a postdoctorate fellow at the department of chemistry, Massachusetts Institute of Technology, U.S.A., has now taken up an I.C.I. Fellowship at the University of Cambridge.

Dr J. L. Latham, *Associate*, has been appointed senior lecturer in physical chemistry, Harris College, Preston, as from 1 September.

Dr F. J. Llewellyn, *Fellow*, Vice-Chancellor and Rector of the University of Canterbury, Christchurch, New Zealand, is now chairman of the University Grants Committee, Wellington, New Zealand.

Dr D. J. D. Nicholas, *Fellow*, head of the chemical microbiology section, Long Ashton Research Station, has been granted leave of absence by the Agricultural Research Council and the University of Bristol from October, 1961, to June, 1962, to take up a Visiting Professorship in Biochemistry at Wisconsin University, Madison, U.S.A.

Dr B. V. Rama Sastry, *Associate*, has been appointed Assistant Professor of Pharmacology, Vanderbilt University School of Medicine, Nashville, Tennessee, U.S.A.

Mr R. A. Rothenbury, *Associate*, has been awarded a postdoctorate research fellowship to work under Professor R. J. Gillespie, *Fellow*, at McMaster University, Hamilton, Ontario, Canada.

Dr D. W. A. Sharp, *Associate*, has been appointed senior lecturer in the department of chemistry, Royal College of Science and Technology, Glasgow.

Dr J. G. Sime, *Associate*, formerly an assistant lecturer in chemistry, University of Glasgow, is now at the School of Chemistry, University of Sydney, Australia.

Dr D. B. Sowerby, *Associate*, formerly instructor in inorganic chemistry, University of Illinois, U.S.A., has returned to England and is now at the department of chemistry, University College, London.

Dr M. E. U. Taylor, *Associate*, formerly a research chemist with Fisons Ltd, has taken up a Norwegian Government postdoctorate fellowship at the Fiskeridirektoratets Havforskningsinstitut, Bergen.

Dr D. W. Theobald, *Associate*, has taken up a post on the staff of the Manchester College of Science and Technology. He formerly held a NATO Fellowship in Organic Chemistry at the University of Strasbourg.

Dr B. Thomas, *Fellow*, formerly reader in agricultural chemistry, has been appointed to a Professorship in Agricultural Chemistry at King's College, Newcastle upon Tyne, as from 1 August.

Dr J. Thomson, *Associate*, has taken up a post as lecturer in chemistry, Queen's University, Kingston, Ontario, Canada, for the session 1961-62.

Dr E. Venkata Rao, *Associate*, of the department of pharmacy, Andhra University, India, is now at King's College, Newcastle upon Tyne, where he will undertake research in organic chemistry.

Dr G. P. Wannigama, *Associate*, of the University of Ceylon, is spending a year studying at the laboratory of the chemistry of natural products, National Heart Institute, Bethesda 14, Maryland, U.S.A.

Mr S. B. Watkins, *Fellow*, head of the department of chemical engineering at King's College, London, has been appointed to the University readership in chemical engineering tenable at that college.

Mr W. V. Wright, *Associate*, formerly a teaching assistant at the University of Illinois, U.S.A., is now studying at the University of Toronto, Canada.

University of London.—The title of Professor Emeritus has been conferred on the following:

Professor Sir Christopher Ingold, F.R.S., *Fellow*, Professor of Chemistry at University College since 1930; Professor W. H. Linnell, *Fellow*, Professor of Pharmaceutical Chemistry at the School of Pharmacy since 1944, and Dean of the School; and Professor D. M. Newitt, M.C., F.R.S., *Fellow*, Courtaulds Professor of Chemical Engineering at the Imperial College of Science and Technology since 1945.

Public and Industrial

Dr J. B. Armitage, *Fellow*, research supervisor, polyolefins division, E. I. du Pont de Nemours & Co., has been transferred from the Experimental Station, Wilmington, Delaware, U.S.A., to take up a similar position at the Sabine River Works, Orange, Texas.

Dr D. S. Berrisford, *Associate*, formerly a research chemist with John Dale Ltd, Bury, has recently accepted a new post with the U.K. Milling Group, Unilever Ltd.

Dr K. E. Bharucha, *Associate*, has returned to this country from India and taken up a position with Imperial Chemical Industries Ltd, Paints Division.

Mr M. D. Boon, *Fellow*, formerly products works manager, Imperial Chemical Industries Ltd, Billingham Division, has been appointed commercial services general manager, as from 14 August.

Lt-Col G. Chignell, *Fellow*, a director of Cerebos Ltd, has been appointed chairman of one of its principal United Kingdom subsidiaries, Brand & Co. Ltd.

Dr L. E. Coles, *Fellow*, has been appointed public analyst and official agricultural analyst for the City of Cardiff and the County Borough of Swansea, as from 1 July. He succeeds Mr S. Dixon, *Fellow*, *q.v.*

Mr A. G. Collings, *Fellow*, has been appointed assistant director of research, London Transport, as from 31 July. He was formerly assistant superintendent of laboratories (chemist).

Mr D. G. Croxon, *Associate*, has been appointed managing director of Kimberley-Clark Ltd. He was formerly works manager.

Dr D. J. Dijkstra, *Associate*, has been appointed gas section manager, Imperial Chemical Industries Ltd, Billingham Division.

Mr C. R. Edmond, *Associate*, formerly an analytical and consulting chemist with Dr R. Gardner & Partners Ltd, Dunedin, New Zealand, has been appointed senior analyst, Australian Mineral Development Laboratories, Adelaide, South Australia, as from 18 September.

Mr J. P. Elder, *Associate*, formerly an investigator with the British Non-Ferrous Metals Research Association, has taken up a research appointment in the division of applied electrochemistry and corrosion, Royal Institute of Technology, Stockholm, Sweden, as from 1 September.

Dr I. J. Faulkner, *Fellow*, formerly ammonia works manager, Imperial Chemical Industries Ltd, Billingham Division, has been appointed products works manager.

Mr E. B. Fielding, *Fellow*, has relinquished his post of chief chemist, J. Wattie Canneries Ltd, Hastings, New Zealand, in order to take up an appointment as chief chemist and bacteriologist, Robert Wilson Food Industries Ltd, Skelmorlie Castle, Ayrshire.

Dr R. Gaze, *Fellow*, chief chemist, Cape Asbestos Co. Ltd, has been appointed a director of the company.

Mr K. W. Hayes, *Associate*, has taken up the position of works manager, Bernard Wardle (Everflex) Ltd, Caernarvon, as from 4 September. He was formerly general manager, James Halstead Ltd.

Mr B. A. Hills, *Associate*, now holds the position of chief chemist, Polymers N.Z. (Pty) Ltd, Otahuhu, New Zealand.

Dr B. H. Howard, *Fellow*, of the Rowett Research Institute, has been awarded a senior research fellowship by the New Zealand D.S.I.R., and will be working in New Zealand for about a year.

Mr R. I. Hughes, *Associate*, a research chemist at the Thornton Research Centre of Shell Research Ltd, has been assigned to the Shell Development Research Laboratory, Emeryville, California, U.S.A., for a period of about 12 months, as from 12 August.

Mr J. H. Keighley, *Associate*, formerly with the Defence Research Board of Canada, has joined the staff of the research and development division, Consolidated Mining and Smelting Co. of Canada, Trail, British Columbia.

Mr F. T. Knight, *Associate*, at present works manager of Alloa Glass Ltd, has been appointed managing director of that company.

Dr F. C. Lloyd, *Fellow*, has joined F. W. Berk & Co. Ltd, in the position of development director, although not a member of the main board. He was formerly research manager of B.X. Plastics Ltd.

Dr R. W. Madden, *Associate*, formerly a research chemist at the Dunlop Research Centre, Birmingham, has taken a post as research chemist at the Carrington Research Laboratory, Petrochemicals Ltd.

Dr R. G. Neville, *Associate*, formerly with the Missile and Space Division, Lockheed Aircraft Corporation, U.S.A., has joined the Aerospace Corporation, Los Angeles, California.

Mr D. H. Oliver, *Associate*, formerly an assistant chemist, Central Metallurgical Laboratory, Anglo-American Corporation, Johannesburg, South Africa, has now taken up a post with Unilever Ltd, food research department, Bedfordshire.

Mr J. Pugh, *Associate*, formerly an industrial chemist, Imperial Chemical Industries Ltd, Dyestuffs Division, has taken up a post with the U.K.A.E.A., Health and Safety Branch, Warrington.

Dr B. L. Rao, *Associate*, formerly with County Laboratories, has now joined Lever Brothers Canada Ltd, Toronto.

Dr C. A. Redfarn, *Fellow*, consulting chemist, has formed an association with Aubrey Wilson, Industrial

Market Research Ltd, to provide a comprehensive commercial and technical consultancy service. This has arisen from the increasing difficulty of divorcing technical problems from their commercial implications. The new organization, 'Technical-Commercial Surveys,' of 1 Dover Street, London, W.1 (Tele: GROsvenor 7207), will offer, apart from technical surveys and consultancy, research into industrial markets at home and overseas, product diversification studies, application studies and a product and price intelligence service.

Dr T. Selvaratnam, *Associate*, formerly with Bataafse Internationale Chemie Mij., The Hague, Netherlands, is now with Petrochemicals Ltd, Carrington, Manchester.

Mr H. E. Styles, *Fellow*, has been appointed director of research, London Transport, with effect from 31 July. He was formerly superintendent of laboratories.

Dr J. Taylor, *M.B.E., Fellow*, a director of Imperial Chemical Industries Ltd, has been appointed to the board of the private company, Nuclear Developments Ltd, recently formed by I.C.I. Metals Division, Rolls-Royce Ltd and the Rio Tinto Co. Ltd.

Dr D. Train, *M.C., Fellow*, reader in pharmaceuticals at the School of Pharmacy, University of London, has resigned his appointment to become a partner in Cremer and Warner, consulting chemical engineers.

Mr H. Warne, *Fellow*, has resigned his position of managing director of William Blythe & Co. Ltd. He has also resigned his seat on the board of the parent and subsidiary companies.

Mr T. G. Webb, *Fellow*, technical superintendent of Goulding Fertilizers Ltd, Dublin, has been co-opted to the board of the company.

Mr K. C. Willson, *Associate*, formerly plant manager, Cassel Works, Imperial Chemical Industries Ltd, Billingham Division, is now with the Uganda Cement Industry Ltd, Tororo, Uganda.

Dr A. G. Winn, *Associate*, has been appointed technical department manager, Imperial Chemical Industries Ltd, Billingham Division, as from 1 December.

Mr G. Winters, *Associate*, has been appointed manager of the heat exchange division of the Wellington Tube Works Ltd. He was formerly projects manager.

Mr R. S. Wright, *Fellow*, formerly division research director, Imperial Chemical Industries Ltd, Dyestuffs Division, has been appointed joint managing director (technical), Billingham Division.

Retirements

Mr S. Dixon, *Fellow*, public analyst and official agricultural analyst for the City of Cardiff and the County Borough of Swansea, retired on 30 June. He had held this appointment since 1929.

Mr H. M. Harvey, *Fellow*, pharmaceutical chemist, of Carshalton, Surrey, has retired.

Dr E. Holmes, *Fellow*, technical services director of Plant Protection Ltd, a subsidiary of Imperial Chemical Industries Ltd, has retired after 33 years with I.C.I.

Mr B. Richardson, *Fellow*, chief chemist to the Northern Gas Board, retired on 31 May.

Mr J. H. St Johnston, *M.C., T.D., Fellow*, chief chemist of Bass, Ratcliff & Gretton Ltd, has retired owing to ill health. He had held this post for almost 14 years, and had been 39 years with the company.

Retirement of Mr Sydney Marks.—Mr Sidney Marks, *Fellow*, assistant head of the chemistry department of the College of Advanced Technology, Birmingham, retired at the end of the academic session after almost 40 years' service. At a private dinner party given in his honour, he recalled some of the changes which had taken place in the chemistry department since he joined it in 1922. At that time there were no day students, and the permanent staff numbered only five. Now, in new buildings, and with a staff complement of 34, the Department caters for nearly 200 full-time students in addition to about an equal number on day release. The introduction of sandwich courses was largely responsible for the swing from part-time to full-time technological education, and Mr Marks thought that the success of these courses was one of the most important and encouraging changes that he had seen during his career in the department.

REGISTER OF FELLOWS AND ASSOCIATES, 1960

Corrigenda

BARCLAY, Alexander. *For* Hon. F.R.P.S. *read* Hon. Mem. R.P.S.

COX, Herbert. *Add Research Dept., after Inorganic Chemistry Section.*

CUNCLIFFE, Percy Walmsley. *For* Cuncliffe *read* Cunliffe.

CUNCLIFFE, William. *For* Cuncliffe *read* Cunliffe.

DRUMMOND, Donald William. *Add* Ph.D. (Edin.).

DRUMMOND, William. *Delete* Ph.D. (Edin.).

GUHA, Sisir Kumar. *Delete* Ph.D. (Bombay).

HONEYMAN, William. *For* Belfast *read* Belfast 5.

LEITCH, James Muir. *For* 11 Gilmourton Crescent, Newton Mearns, *read* 11 Gilmourton Crescent, Newton Mearns.

LEWIS, David Thomas. *For* Chemist *read* Government Chemist.

MILES, Grant Lewis. *For* Atonomic *read* Atomic.

NURSE, Edwin Hart. *For* Wordbury *read* Woodbury.

PRESCOTT, John Ray. *For* Cleanese *read* Celanese.

THOMAS, Richard Spenser. *For* Dunstan *read* Dunstall; *for* Wolverhampton 51266 *read* Wolverhampton 51226.

THOMSON, Alexander Francis. *For* A 1933 *read* A 1943.

TURNER, George Hugh. *For* Dunabin *read* Dunbabin.

VARSHNEY, Ishwar Prasad. *For* Muslim *read* Muslim.

VILLIERS, Ralph Frederic (Graduate Member). *Add* A.T.I.

Section Activities

EAST ANGLIA

Works Visit. On 12 August a party of members visited the Key Glassworks Ltd, Harlow New Town. This company manufactures glass containers for all types of foodstuffs, minerals, medical supplies, cosmetics and so on. The factory is one of the most advanced glassworks in Western Europe.

Members of the technical staff conducted the party round the works. The tour included demonstrations of the various stages in the manufacture of the glass, the production and packaging of the containers and a visit to the control laboratories. The party was then entertained to lunch.

Mr D. E. Herring expressed the thanks of the party to the company.

LONDON: SUMMER VISITS

Wye College. A party of members and guests assembled at Wye College on 8 July to be shown some of the activities of the College. After coffee had been served, Professor R. L. Wain, F.R.S., gave a short talk. Those present were interested to hear an historical account dating back to the 15th century. Professor Wain explained the relationships of the College with the University of London and the Agricultural Research Council, and indicated some of the lines of work in progress.

The rest of the morning was devoted to a tour of the laboratories and inspection of an exhibition showing aspects of the work of the Department of Physical Sciences and Agricultural Research Council Unit of Plant Growth, regulating substances and systemic fungicides. Members and guests were particularly grateful to all those who had been involved in the provision of such elaborate demonstrations, and much appreciation of the exhibition was expressed.

After an excellent lunch, a short visit was made to the library and buildings of historic interest. The rest of the afternoon was spent in the open air, although unfortunately the weather was unfavourable. An hour was spent in the horticultural department, where after seeing numerous varieties of pot plants the party showed much interest in the mobile greenhouse, which may be moved quite simply to cover four crops each year.

At this stage the party divided for the more energetic to undertake a farm tour and others to be shown the gardens at Withersdane. An enjoyable and instructive tour in the environs of Coldharbour Farm was made, during which the grain dryer and pea-vining equipment were seen.

After tea Mr L. M. Miall expressed the thanks of the Section to Professor Wain, Dr Margaret Smith and others concerned with the arrangements for the visit, and to the guides. In particular, it was appreciated

that the staff had given up their time on a Saturday to provide a visit which particularly appealed to Section members, their wives and friends. In acknowledgement, Professor Wain said that the College was honoured that the visitors were prepared to devote a Saturday to inspecting the work of the College.

Those members of the party who had not previously done so were able to see the gardens after tea to conclude a memorable day.

Pulp and Paper Mills. On 12 July a party visited Bowaters United Kingdom Pulp and Paper Mills Ltd's Thames Division and group research laboratories at Northfleet. Members were received by the chief chemist, Mr W. Holden, who gave a brief introduction. Explanatory leaflets handed to each member describing the processes used and the organization at Northfleet added greatly to the interest of the tour.

The party was then divided into small groups and taken first to the paper mill. The mill control laboratories were visited, and routine testing of materials and the making of sample sheets of paper from various pulps were seen. The new power plant was next visited, and then the paper-making process itself was demonstrated, starting at the jetty where pulp is unloaded and following the process through the stages of hydropulping, beating and converting into paper. After this the supercalendering, reeling and packing operations were seen. Tea was then provided and as this was the only occasion when all the party was present the opportunity was taken to thank the management and the guides for a very interesting and carefully organized visit.

The group research laboratories were then visited, this part of the visit being introduced by Mr L. W. Causer, deputy research manager. The very wide range of investigations taking place was explained in detail, and many members had an opportunity for discussions with specialist members of the staff.

County Analyst's Laboratory. On 28 July, a party of members visited the laboratory of the Kent County Analyst, Mr H. E. Monk, at Maidstone. Mr Monk outlined the reasons for the laboratory's existence, and its relationship to the various public authorities served.

The party was then divided into two groups and shown over the laboratory by senior members of the staff, who explained the different types of work carried out. These range from routine analyses of foodstuffs of various types to forensic investigations on behalf of the police. The use of spectroscopic, chromatographic and optical methods of analysis was illustrated by several interesting exhibits of work carried out by the laboratory. The method used for the routine determination of radioactivity in milk and in rainfall, which has been carried out in Kent for some time, was also explained.

After tea, the vote of thanks to Mr Monk and his staff was proposed by Mr F. Tweedie on behalf of the visitors and the Kent Sub-Section.

MANCHESTER AND DISTRICT

Shell Refining Co. Ltd, Stanlow. A party of members had ideal weather for their visit to Stanlow on 13 June. The complex working of the refinery was first described to the visitors with the aid of a model representing about four square miles. Numerous charts and samples showed the principal reactions which are carried on in the refinery, leading to the production of high-octane motor spirit, methyl isopropyl carbinol and methyl ethyl ketone, and gave an indication of the methods of producing various petroleum chemicals. The visitors were then taken on a conducted tour of the refinery,



and found the distillation plant, catalytic cracking unit and sulphur-recovery plant of particular interest. A tour of the chemical plants followed a break for tea. Mr G. Walker, on behalf of the party, thanked the hosts and guides for making the visit so interesting.

Quickfit and Quartz Ltd, Stone. On 28 June a party of members and their ladies visited the works of Quickfit and Quartz Ltd at Stone. The party assembled at the Crown Hotel, and after an excellent lunch toured the factory in two groups. The tour began in the heavy industrial section, in which glassware for chemical plants was being produced. Members were able to appreciate the amount of time and energy spent on a vessel such as a 50-l distilling flask when they saw three or four men armed with oxy-coal-gasblow torches working continuously round a revolving 2-ft sphere of red-hot glass. After the intense heat and noise of this section a break for tea was very welcome. The party was then taken to the laboratory apparatus section. Here much more familiar objects were to be seen, and cones, sockets, flasks, beakers and so on were being produced at a remarkable speed. In the department devoted to special orders, the individual glass blower was more prominent than in the other highly-mechanized section. It was interesting to find that all the highly skilled glass-blowers were local people aged 16-60 years.

A vote of thanks to the company and the staff who conducted the tour was expressed by Mr G. Walker. Members left the factory feeling that they had learnt a great deal and that it had been a most successful visit.

Forthcoming Symposium

The Section and the Society of Chemical Industry are holding a joint Symposium on 'Polyurethane Foams' on 3 November at 2 p.m. The President of the S.C.I., The Lord Fleck, K.B.E., F.R.S., has accepted an invitation to attend this Symposium, which will be held at the Manchester Literary and Philosophical Society, 36 George Street, Manchester. The following lectures will be delivered: 'Technology and Applications of Flexible One-Shot Polyether Urethane Foams' by G. K. Dono and G. G. Shelton, of Union Carbide Ltd; 'Development of Production Methods of Polyurethane Foam in Germany' by Dr Weinbrenner, of Bayer; and 'Properties of Rigid Polyurethane Foams' by D. J. Doherty and R. Hurd, of Imperial Chemical Industries Ltd, Dyestuffs Division. Dr Weinbrenner will also show a short film.

There will be an interval for tea between the lectures, and after the meeting members of the Symposium are invited to a dinner given by kind invitation of the directors of I.C.I. Dyestuffs Division in the restaurant of Hexagon House at 7.30 p.m. Tickets for the Symposium can be obtained from Mr H. H. Armstrong, Head of the Science Department, Stockport College of Further Education, Wellington Road South, Stockport.

NORTH LANCASHIRE

Works Visit. A party visited the research laboratories of Pilkington Bros Ltd, Latham, Ormkirk, on 6 July. The visitors were divided into small groups for a conducted tour of these magnificent new laboratories, where research was being carried out in almost every field of physical chemistry, with particular reference to improvements in the products of the glass industry.

The techniques used ranged from conventional chemical analyses and microscopical examinations to X-ray fluorescence spectroscopy, mass spectrometry for the analysis of the gas content of minute bubbles in glass, radiochemistry and even metallurgy.

Of particular interest was the successful use of spectroscopic evidence in elucidating the conduction of heat through molten glass. This is now shown to be largely the result of absorption and energy transfer by small amounts of impurities, notably iron, in the glass, and only to a small extent by thermal conduction. Considerable progress was also being made in explaining the mechanism of solid-state reactions, using a thermobalance arranged to measure directly the reaction rate versus the rate of change of temperature.

Many and varied types of glass were on display, from solid ingots to small fibres.

In thanking the company and its staff for a memorable and instructive visit, Mr A. N. Edmondson remarked on the fantastic complications which had arisen in what

we tend to consider a simple process. Replying, Mr H. Cole, the deputy director, said that he for his part was gratified by the interest shown.

DECCAN

Film Show. By courtesy of the Bangalore Branch of the Field Publicity Organization of the Government of India, two films of topical interest were shown on 3 July in the lecture hall of the department of inorganic and physical chemistry, Indian Institute of Science, Bangalore. 'Rabindranath Tagore,' a documentary film produced to mark the centenary of the birth of this great poet and philosopher, detailed the genealogy of the ancient and cultured Tagore family of Bengal; the educational growth of Rabindranath Tagore; the influence of his early contact with nature and humanity on his later prose and poetic writings, which won him the Nobel Prize for literature in 1913; his effective interference in the partition of Bengal; his meetings with Mahatma Gandhi, Romain Rolland, Albert Einstein and others; the founding of the Visva-Bharati University at Santiniketan; his attitude to the political events and global conflicts which occurred during his lifetime; and his death in 1941.

'A Visit to Remember,' a colour film, highlighted some aspects of the recent visit of the Queen and the Duke of Edinburgh to India. It showed Her Majesty participating in the colourful celebrations of the Republic Day at Delhi with all its pomp and pageantry; riding an elephant at Varanasi; touring the laboratories of the Indian Institute of Science at Bangalore; watching the races at Mahaluxmi, Bombay; and evincing keen interest in the working of the steel mill at Durgapur and the community-development work at Bhankrota, near Jaipur, which indicated that India was making rapid technological and economic progress.

Dr B. H. Iyer proposed the vote of thanks to Mr Gavirayappa and his associates for showing the films.

EAST AFRICA

Chemotherapy in Japan. On 21 June the Section joined with the Nairobi Scientific and Philosophical Society and the Faculty of Science at the Royal College, Nairobi, to welcome Professor Shiuji Hasegawa, Emeritus Professor of the University of Tokyo and President of Gunma University.

Professor Hasegawa began his lecture on 'Research Work on Chemotherapy in Japan' with a survey of studies at present being undertaken in Japanese universities and research institutions. He then concentrated on the antibiotics, with particular reference to kanamycin and mikamycin. Work on these drugs had been developed because of the importance of dealing with strains of staphylococci, and dysentery and tubercule bacilli, which had become resistant to the earlier antibiotics. The separation of kanamycin from growths of *Streptomyces kanamyceticus* was described, together with

work on the chemical structure of the compound. Important characteristics of the drug were the lack of cross-resistance with streptomycin and the low toxicity indicated by animal experiments. A very low level of absorption from the gut made it particularly suitable for intestinal infections. *Streptomyces mitakaensis* was of particular interest in producing two active products which exhibited a strong synergistic effect.

After his lecture, Professor Hasegawa showed a remarkable colour film of the life history of the hookworm. Questions followed, and the Chairman, Professor R. F. Naylor, then expressed the appreciation of the meeting for the opportunity of hearing from so distinguished a worker in the field of chemotherapy.

Acting Honorary Secretary. Mr Norman Kirby has taken over the duties of Acting Honorary Secretary of the Section, following the death of Professor R. F. Naylor in a car accident in Northern Rhodesia on 6 August.

EASTERN INDIA

Oil-soluble Coal Tar Dyes in Chilli. A joint meeting with the Institution of Chemists (India) was held on 27 January in the lecture theatre of the School of Tropical Medicine, Calcutta, with Dr U. P. Basu in the Chair. Mr S. N. Mitra, director of the Central Food Laboratory (Calcutta), gave a lecture on 'Further Studies on the Detection of Oil-soluble Coal-Tar Dyes in Chilli.'

After discussing the importance of the detection of oil-soluble coal-tar dyes in the analysis of a spice-like chilli, Mr Mitra pointed out briefly the analytical methods likely to be employed for the purpose, which included preliminary colour reactions followed by confirmation of the components by the paper chromatographic method. Of the different colour reactions studied, those involving treatment of the alcoholic extract of the sample with concentrated hydrochloric acid or of the ether extract with the concentrated or dilute acid (1:1, 3:1 or 4:1) were found to be highly satisfactory. The paper chromatographic analysis was carried out on the alcoholic extract of the sample using 80% alcohol as the irrigating solvent. The natural colouring matter of chilli could be easily distinguished from the coal-tar dyes, particularly because of the fact that the colour of the latter substances remained practically unaltered for months, whereas that of the former disappeared within a few days on keeping the chromatogram in the room air. Mr Mitra finally mentioned the R_f values of a number of important oil-soluble coal-tar dyes which might be used for colouring chilli.

The lecture was followed by an interesting discussion, and the meeting terminated with a vote of thanks to the speaker proposed by Dr U. P. Basu.

Erratum:—On J. 200, the date of the A.G.M. of the Deccan Section should read 28 January, and the name of a Member of Committee Dr A. Sreenivasan.

News and Notes

EXHIBITIONS AND COURSES

Chemical Engineering Exhibition.—The Second Chemical and Petroleum Engineering Exhibition is to be held at Olympia, London, on 20–30 June, 1962, under the joint sponsorship of the British Chemical Plant Manufacturers' Association and the Council of British Manufacturers of Petroleum Equipment. It will be the largest exhibition of chemical plant ever held in Europe. A lecture theatre to accommodate 1,000 people will be built on the first floor of the Empire Hall, where the Third Congress of the European Federation of Chemical Engineering will be held during the course of the Exhibition. The Fourth Congress of the Federation of European Petroleum Equipment Manufacturers will be held on 25–28 June at Church Hall, Westminster, when some 20 technical papers will be presented. Further information may be obtained from *Engineering in Britain*, 34 Victoria Street, London, S.W.1.

Degree Courses in Food Science.—New courses, leading to Honours and Ordinary B.Sc. degrees in Food Science, have been introduced at the University of Leeds. The first students for these courses will enter the University in October, 1962. The Honours course extends over four years, and includes chemistry, physics, biology, statistics, bacteriology and biochemistry, taken in the appropriate pure science department in the first years. This is followed by courses in the chemistry, physics and microbiology of foodstuffs and food processing. The Ordinary degree course is restricted to three years. Entry requirements include a high standard in chemistry and physics, with mathematics as the preferred third subject. Postgraduate students will be able to take the Postgraduate Diploma in Food Science or carry out research for the M.Sc. and Ph.D. degrees. Further details may be obtained from Professor A. G. Ward, Procter Department of Food and Leather Science, The University, Leeds, 2.

Effluent and Water Treatment Exhibition.—The Second Effluent and Water Treatment Exhibition and Convention to be held at the Seymour Hall, London, from 31 October to 3 November will be nearly twice the size of that held in 1960. Increasingly severe restrictions are being imposed by river authorities on the type of effluent discharged. The growing volume of water required for industry cannot always be provided economically from available sources, and recovery of used water is of prime importance. Both these subjects are well represented at the Exhibition by new designs and techniques. Registration for the Convention is £4 per delegate, and forms are obtainable from the organizers, Thunderbird Enterprises Ltd, 140 Cromwell Road, London, S.W.7.

Research Methods and Instrumentation.—The Eleventh Annual Instrument Symposium and Research Equipment Exhibit will take place on 9–12 and 10–13 October, respectively, at the National Institutes of Health, Bethesda 14, Maryland, U.S.A. Many leading manufacturers of electronic, mechanical and optical instruments for laboratory and clinical research will be taking part in the exhibition. This year's symposium will consist of seven sessions, and the opening session will deal with applied gas chromatography. Further details may be obtained from the executive secretary, Mr James B. Davis, at the National Institutes of Health.

MEETINGS AND CONFERENCES

Audio-Visual Aids and Staff Training.—An international colloquium on 'Audio-Visual Aids and Staff Training in Industry' will be held in Antwerp on 18–21 October. The participation fee is 1,000 Belgian francs. Information may be obtained from the Secretary's Office, Frankrijklei 128A, Antwerp, Belgium.

Freeze-Drying of Foodstuffs.—A Symposium on 'The Freeze-Drying of Foodstuffs' will be held at the department of chemistry, Borough Polytechnic, on 19–20 October. The symposium will deal with the development of freeze-drying techniques, a survey of the commercial equipment at present available and a discussion of the potentialities of the technique in various branches of the food industry. Nutritional aspects will also be included. The panel of lecturers will include a number of persons who were concerned with the development of A.F.D. at Aberdeen and others who are at present installing and operating commercial equipment. Pilot plant and model freeze-drying equipment, samples of freeze-dried products and packaging materials will be on display. Further details can be obtained from the Secretary, Borough Polytechnic, Borough Road, London, S.E.1.

Organic Chemistry of Natural Products.—On the occasion of the 75th anniversary of its foundation the Société Chimique de Belgique is organizing an international symposium on 'The Organic Chemistry of Natural Products' (excluding steroids and polypeptides). This will take place in Brussels on 12–15 June, 1962. Seven plenary lectures will be given, including one by Professor Sir Alexander Todd, F.R.S., *Nobel Laureate*. The symposium will be divided into five sections: structure of new natural products; methods used for the determination of chemical structures; syntheses and chemical reactions (excluding degradation reactions); biosynthetic theories and their experimental verifications; and mode of action of naturally-occurring compounds in biological processes. Papers will be limited to 20 minutes, discussions included. Summaries, which should not exceed 200 words, should

reach the Secretariat of the Symposium before 1 February, 1962. Further information may be obtained from the Secretariat, c/o Fédération des Industries Chimiques de Belgique, 32 rue Joseph II, Brussels, 4.

Oxidation Processes.—A symposium on 'Oxidation Processes in Chemical Manufacture' is to be held by the London Section of the S.C.I. in the William Beveridge Hall, Senate House, University of London, London, W.C.1, on 28–29 September. The registration fee for members of the S.C.I. is £1 and for non-members £4. Further details may be obtained from the Assistant Secretary of the S.C.I., 14 Belgrave Square, London, S.W.1.

Physics of Semiconductors.—An International Conference on the Physics of Semiconductors is being organized under the auspices of IUPAP and the British National Committee for Pure and Applied Physics of the Royal Society by the Institute of Physics and the Physical Society. It will be held at the University of Exeter on 16–20 July, 1962. Further information may be obtained from the Administration Assistant of the Institute of Physics and the Physical Society, 47 Belgrave Square, London, S.W.1.

Polarographic Society.—A meeting of the Society will be held on 25 October at 2.45 p.m. at the School of Pharmacy, 29–39 Brunswick Square, London, W.C.1. Professor W. H. Linnell will be in the chair, and Professor Dr M. von Stackelberg, of the University of Bonn, will read a paper (in English) entitled 'Some Special Problems in the Polarography of Indium and Tellurium.' He will be presented with the Society's Medal for the current year. The secretary of the Society is Mr J. H. Glover, 75 Craven Gardens, Wembley, London, S.W.19.

Techniques of Polymer Science.—The Plastics and Polymer Group of the S.C.I. is arranging a symposium on this topic, to be held in London on 27–28 September, 1962. Papers concerned with novel techniques in the fields of polymer synthesis, analysis, including structural analysis, and the measurement of physical properties will be especially welcome. Summaries of proposed contributions should be sent to the Convener, Plastics and Polymer Group Symposium Sub-Committee, 14 Belgrave Square, London, S.W.1, before 1 December. The complete typescripts of papers provisionally accepted for the symposium will be required by 1 June, 1962.

Vacuum Science and Technology.—The Institute of Physics and the Physical Society is holding a symposium on 'Some Aspects of Vacuum Science and Technology' at the Imperial College of Science and Technology, London, on 5 January, 1962. The scope of the symposium will be: continuously-exhausted bakeable vacuum apparatus for pressures below 10^{-9} mm

of mercury; and the controlled deposition of evaporated film. Further details and application forms will be available about the end of October from the Administration Assistant, The Institute of Physics and the Physical Society, 47 Belgrave Square, London, S.W.1.

Water Treatment and Examination.—The Society for Water Treatment and Examination will be holding its Autumn Meeting this year on 20–22 September at Great Yarmouth. The headquarters of the meeting will be the Carlton Hotel. All papers to be presented will be published in full in the *Proceedings* of the Society, price 10s. 6d., which may be obtained from the Hon. Secretary, A. W. H. McCanlis, 41 Carshalton Road, Sutton, Surrey.

EDUCATIONAL

National Council for Technological Awards.—During the period April, 1960, to March, 1961, 309 students were awarded Diplomas in Technology, bringing the total number awarded to 472. This is stated in the fourth annual Report of the National Council, recently issued. There are now nearly 5,000 students following courses leading to the Diploma in Technology, of whom 1,200 are college-based and about 3,800 industry-based. Altogether there are 100 courses now in progress, and a further 13 proposed courses have been approved.

In the field of applied chemistry there are 13 courses in operation, with a total of 512 students. Of these, 219 are in the first year of their course compared with 163 a year ago. Diplomas in Technology have been awarded to 40 students who successfully completed courses in applied chemistry; of these 8 were awarded first-class honours, including one woman, and 22 obtained second-class honours.

The Report refers to the College of Technologists which was established in 1959 to administer an award higher than the Dip. Tech. (the M.C.T.) for those students who successfully complete an approved research project. So far the College has received 34 applications for registration, of which 27 have been accepted and a further five are still under consideration. Eight of the registered applicants are working in the field of applied chemistry.

As from November, 1961, the Institute will have two representatives on the Board of Studies in Technologies other than Engineering, instead of one as at present. These will be Dr N. Booth and Professor W. Bradley; they succeed Dr J. W. Cook, F.R.S., who has represented the Institute and served on the Governing Body of the National Council since its inception in 1955.

O.E.E.C. Summer Course.—A Summer Course entitled 'New Programmes in Chemistry for Schools' was held in Dublin from 3 to 28 July. The Course, under the joint auspices of the Organization for European

Economic Co-operation and the Irish Department of Education, took place in the Chemistry Department of University College, Dublin. Lecturers and delegates from the United States, United Kingdom, Belgium, Sweden, West Germany, Norway, Italy, Turkey and the Irish Republic participated.

The basic theme was the further consideration of the proposals made at an O.E.E.C. Seminar held in Greystones, Ireland, in 1960 (*see J.*, 2) and also their re-evaluation in the light of subsequent teaching experience. The Belgian delegation presented the opening lectures, which consisted mainly of a description of the members' experience in teaching the junior syllabus (14–16 years), drawn up at the Greystones Seminar. The lectures on the senior course (16–18 years) were introduced by the American delegation, which included representatives of both the Chemical Bond Approach (C.B.A.) and Chemical Education Materials Study (CHEM Study) projects. The teaching of physical chemistry in schools, including acid–base theory and reaction mechanisms, was described by the Swedish delegates. The German delegates outlined their experience in teaching electrochemistry. Mr N. Booth, H.M. Inspector (U.K. delegate), described the teaching of chemistry in grammar schools in England and Wales, with special reference to the position of thermochemistry in the syllabus. He also outlined the proposed new syllabuses of the Science Masters' Association. Lectures on organic chemistry, radiochemistry and the periodic classification of the elements were presented by lecturers from University College, Dublin.

The course included several periods for practical work, when delegates were given opportunities to carry out a variety of experiments suitable for school chemistry classes. The frequent discussion sessions covered a wide range of topics, *e.g.* oxidation and reduction, acid–base theory, textbook errors, ionization potential and electronegativity.

Whereas practice in chemistry teaching tended to differ widely in the different countries represented, there was a general feeling that the new approaches to the teaching of chemistry had proved most successful during the short period in which they had been on trial. It was also agreed that there was need for frequent revision. Furthermore, several separate approaches to chemistry teaching, such as the C.B.A., CHEM Study and the new S.M.A. syllabuses, were useful, and frequent transfusions of information were important.

Participants included Professor Benfey, United States, who represented the C.B.A. project, Dr Jodogne, Inspector, Belgian Ministry of Education, Mr A. J. Mee, Scottish Department of Education, and Professor Eva M. Philbin, University College, Dublin. The Institute was represented by Mr D. G. Chisman, *Education Officer*. The Course was directed and organized by Dr D. G. O'Callaghan, Inspector, Department of Education, Republic of Ireland.

RECENT PUBLICATIONS

British Standard for Letter symbols, signs and abbreviations.—Four new parts of BS 1991 relating to specialized aspects of this subject have been issued. Part 1 (General) of BS 1991, which was issued in 1954, contained recommended symbols, signs and abbreviations for the fundamental quantities of interest to physicists, chemists and engineers. As far as practicable, the recommendations followed the decisions of international organizations. In addition to the actual symbols recommended, other important matters dealt with included the principles governing their choice and their lay-out in printed articles. Part 1 was amended in certain respects in October, 1960, by the issue of PD 3920, and a comprehensive revision will be undertaken shortly.

In the additional parts now published, the principles and recommendations of Part 1 have been followed and the interconsistency of all the parts maintained as far as practicable. These additional parts are:

Part 2: Chemical engineering, nuclear science and applied chemistry (10s.);

Part 3: Fluid mechanics (7s. 6d.);

Part 4: Structures, materials and soil mechanics (12s. 6d.);

Part 5: Applied thermodynamics (7s. 6d.).

Each new part gives symbols for quantities and abbreviations for units in the fields covered by the title, and also includes a selection of the symbols and abbreviations recommended in Part 1 (General), so as to avoid the need for frequent reference to Part 1.

Copies of separate Parts of this Standard may be obtained, at the prices indicated above, from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1.

Determination of Chlorides.—W. G. Pye & Co. Ltd, Granta Works, P.O. Box 60, Cambridge, have recently published the first of a series of handbooks dealing with electro-analytical methods. This first number, entitled *Determination of Chlorides*, is written by T. A. Strivens, a chemist employed in the company's research laboratories, and costs 10s. 6d. post free direct from the company.

After very brief comment on the classical volumetric and gravimetric procedures, this book summarizes the electroanalytical methods for chloride determination and gives 175 references. Whilst a detailed critical account is impossible in a book of this size, the author does attempt to give some idea of the degree of precision and the time required for the various methods. Brief consideration is also given to interfering ions and to special applications such as water analysis, biological determination and so on. The only points of criticism are the absence of any mention of the use of a glass

electrode as reference electrode in chloride titration, and the inclusion of a table in Appendix I, which implies the knowledge of single-ion activity coefficients for the chloride ion. This is a small handbook useful for the practising analyst concerned with chloride determination.

R. W. BOLLAND

Warren Spring Laboratory Report.—In reporting on the Laboratory's first full year of operation, 1960 (*Report of the Warren Spring Laboratory: 1960*, published for D.S.I.R. by H.M.S.O., 3s. net), Sir Harry Jephcott, chairman of the Research Council and of the Laboratory's steering committee, draws particular attention to the success of the mineral processing division in attracting short-term work on a repayment basis, and expresses the hope that this will lead to longer-term work in the future.

A national survey is being carried out, in co-operation with local authorities, to provide detailed and accurate information about air pollution by smoke and sulphur dioxide throughout the country. Pollution measurements are being made at selected sites in towns chosen, on a statistical basis, as representative centres. When the survey is complete it should provide a picture of pollution in this country, against which pollution in various towns can be compared.

The chemical engineering division is carrying out basic research on bubble formation, which should lead to increased efficiency in gas absorption and distillation equipment. The division is also working on the problems of control of distillation equipment by computer.

Though technological research at the Laboratory on the Fischer-Tropsch process is being discontinued, allied work on catalysis is being carried out, and during 1960 the relation between electric properties and catalytic activity of iron oxide (Fe_2O_3) containing small concentrations of titanium dioxide was investigated. The steering committee has also agreed that the Laboratory should keep in touch with developments in the general field of oil-from-coal research through the literature and by personal contacts and visits.

The mineral processing division is a centre of research for the mining industry at home and overseas, and during 1960 about three-quarters of its work was on a repayment basis for industry and government. Experiments are being planned to explore the possibilities of introducing automatic control in mineral-dressing plants.

An investigation has now been started to determine the long-term effectiveness and general acceptability of methods for removing oil from beaches and for dealing with oil floating on the sea. To assist holiday resorts during the present season the Laboratory sent a report to coastal local authorities containing suggestions for dealing with this problem.

American Chemical Society.—The Society announces that it has broadened its service to the field of

medicinal chemistry by acquiring the *Journal of Medicinal and Pharmaceutical Chemistry* from Interscience Publishers, Inc. Dr Alfred Burger, Professor of Chemistry at the University of Virginia, has been reappointed editor. The publication was founded in 1959 by Dr Burger in association with Dr A. H. Beckett, of Chelsea College of Science and Technology. Dr Beckett has accepted appointment to the editorial advisory board. The journal, a bimonthly, will first appear as an A.C.S. publication in January, 1962. Its title will be changed in 1963 to the 'Journal of Medicinal Chemistry.'

A new bimonthly publication is soon to be published by the A.C.S. The first issue of *Bio-Chemistry* is to appear in January, 1962. Professor Hans Neurath, executive officer of the biochemistry department of the University of Washington's School of Medicine, has been appointed editor. The purpose of *Bio-Chemistry* is to publish the results of important original research in all areas of fundamental chemistry. The journal will emphasize the relationship of chemistry to biochemistry, and of biochemistry to the other biological sciences.

Examinations on Radiation Safety Practice.

The City and Guilds of London Institute has announced the introduction of a new examination intended to provide a basic qualification for full-time non-professional supporting staff employed on health and safety duties in those industries using radiation and radioactive materials. The decision to offer this examination was taken after considering a request from the U.K.A.E.A., which was implementing the recommendation on the training of Category C personnel made in the Report of Sir Douglas Veale's Committee on Training in Health and Safety (H.M.S.O., 1960).

The examination syllabus, prepared with the co-operation of both sides of industry and the teaching profession, is designed to test the candidates' skill in the use of standard instruments and equipment for measuring and recording the amount and type of radiation and radioactive contamination in laboratories, plants and inside and outside buildings; and for monitoring personnel, clothing and equipment. A part-time course of at least 225 hours' duration is envisaged, and at least 45 per cent of this time should be spent on practical work. The examination will consist of written and practical papers, and a special practical and oral test on nuclear reactors will be available for those wishing to obtain an endorsement certificate.

Full details of the examination syllabus and regulations, published as Subject 290—Radiation Safety Practice—may be obtained from the City and Guilds of London Institute, 76 Portland Place, London, W.1.

Industrial Water and Effluents.—A new subject group of the S.C.I., the Industrial Water and Effluents Group, is being formed under the chairmanship of Dr B. A. Southgate, director of the water pollution

research laboratory of the D.S.I.R. The Group will be interested in all aspects of the science and technology of treatment, conservation and economic use of water and of the treatment and disposal of effluents. The first meeting will take place on 1 November at the Royal Institution, 21 Albemarle Street, London, W.1. Those interested in membership of the Group are invited to write to the General Secretary of the S.C.I., 14 Belgrave Square, London, S.W.1, or to the Group Secretary, J. L. Hewson, Esq., c/o Chemical Engineering Services, Imperial Chemical House, Millbank, London, S.W.1.

News of Soviet Science and Technology.—Seventeen of the leading Russian technical journals are translated into English and published every month by British research associations and scientific societies for the Department of Scientific and Industrial Research. These provide up-to-the-minute information on Soviet progress in steel manufacture, castings, welding, rubber and plastics, production engineering, machines and tooling, instrument construction, textiles, wood processing, chemistry, biology and mathematics. The D.S.I.R. also sponsors the translation and publication of Russian technical books, and each year places on sale translations of hundreds of technical articles. These translations are obtainable from the new National Lending Library for Science and Technology, which also has available on loan a further 20,000 individual translations. Inquiries should be addressed to the Director of the Library, Boston Spa, Yorkshire (Tele: Boston Spa 2031).

Reed Paper Group.—A new research and development centre is under construction by the Reed Paper Group at its Aylesford (Kent) site. The first stage comprises a £500,000 laboratory, providing about 50,000 sq. ft of laboratory floor area, a pilot plant building of about 12,000 sq. ft and office space amounting to 10,000 sq. ft. The laboratory is expected to be ready for occupation in May, 1962.

CORRESPONDENCE

SCIENCE FOR THE BLIND

SIR,—The Royal National Institute for the Blind is experiencing considerable difficulty in the matter of transcribing textbooks into Braille for those who are now studying science and mathematics. This is explained in an article (*see* p. 321) written by Professor Bickley, who is himself blind and Emeritus Professor of Mathematics, University of London.

Students in schools and colleges are becoming more and more concerned with science and mathematics. The students who are blind are no exception to this present trend, but they work under an additional

disadvantage—the shortage of textbooks. The blind student who reads law, history, English modern languages and similar subjects is well provided for through the Royal National Institute for the Blind Students' Library, but this is not true of science and mathematics.

Many men and women who are students in the broadest sense of science and mathematics wish to be kept in touch with modern developments. They also are deprived of the right kind of literature in these subjects.

A committee has been working for some years past in preparing a suitable code so that chemical and other formulae can be easily transcribed into Braille, but the readers of scientific journals will readily understand that a code is not much use unless it can be used for the transcription of modern textbooks into Braille. The main difficulty in this is that the usual volunteer Braille transcribers cannot do this work. Whilst there is an excellent army of volunteer transcribers for books in law, history and so on, these volunteers do not understand the language of science and mathematics sufficiently well to be able to use the code correctly.

Volunteers are required urgently for this work, which would occupy them for a minimum of four to five hours per week if it is to be of practical use. Those who would like to take part in this worthwhile volunteer occupation should apply to: Miss Ogilvy, Head of Students' Library, Royal National Institute for the Blind, 224 Great Portland Street, London, W.1.

J. A. ORIEL

St Helen's Court,
Great St Helen's,
London, E.C.3

GRAMMES AND GRAINS

SIR,—Referring to Mr A. L. Bacharach's challenge on a minor point in his review of *World Review of Nutrition and Dietetics*, Volume II (*J.*, 268), may I point out that a badly written 'gram' is indistinguishable from a badly written 'grain.' As a result of somewhat bitter experience, I have for many years asked all the indistinct writers on my staff—normally 100 per cent—to spell 'gram' in the old-fashioned but less ambiguous way 'gramme.'

I cannot imagine Mr Bacharach making the exclamation 'dear me,' but should he think in those terms I would accept his point of view that brevity is economical. Nevertheless, on balance, the valuable second devoted to writing 'me' would in some circumstances save much costly confusion on a later occasion and the small expense involved prove a sound investment.

F. C. BULLOCK

City Analyst's Laboratory,
7 Salisbury Road,
Leicester

OBITUARY

Philip Sidney Allam. *B.* 31.5.03. *Ed.* Brentwood School; University College, London, 1921-23. *B.Sc.* In 1924 he took a post as assistant chemist with the Lagunas Syndicate Ltd, Iquique, Chile. He returned to this country some three years later to become a patent agent assistant with D. Young & Co. Whilst there, he qualified as a chartered patent agent and in 1937 set up his own practice as a patent agent. He continued in charge of the practice for the rest of his life. (*A.* 1925) *D.* 29.4.61.

Herbert Henry Bell. *B.* 28.6.1899. *Ed.* Ayr Academy; Paisley Technical College, 1919-20; University of Glasgow, 1920-23. *B.Sc.* He served in H.M. Forces, 1917-19, before completing his education. In 1923 he joined the Ayrshire Coalowners' Association as an analyst. He left in 1930 to become a teacher of science and mathematics under the Ayrshire Education Committee. Later, he became headmaster of Russell Street Junior Secondary School, Ayr, a post which he held for the rest of his life. During the Second World War he served as a bomb safety officer in the Unexploded Bomb Department of the Admiralty. (*A.* 1924) *D.* 3.4.61.

Thomas Cockburn. *B.* 11.10.1880. *Ed.* Hutcheson's Grammar School and Shawlands Academy, Glasgow. In 1899 he became a chemist to the Glasgow Portland Cement Co. Ltd, and a year later joined the Millom & Askam Haematite Co. Ltd as an assistant chemist. In 1901 he was appointed first assistant to Mr F. W. Harris, Glasgow Corporation Chemist and City Analyst, becoming chief assistant a few years later. He became head of the department on the retirement of Mr Harris in 1935 and held the position until his own retirement in 1945. He acted also as a part-time lecturer in Paisley Technical College, and was the author, or joint author, of a number of scientific papers. Essentially a man of the country, his many interests included shooting and fishing. He was a one-time player for Queen's Park Football Club, and was a keen golfer. 'He will probably be best remembered and respected for his straight and direct dealing and his honesty of purpose, qualities which he combined with a humanity by which he endeared himself to all who had the privilege of knowing, working and playing with him.' (*F.* 1909) *D.* 21.4.61.

William Roy Cecil Coode-Adams. *B.* 11.8.1895. *Ed.* St Paul's School, London; Pembroke College, Cambridge, 1914-15, 1919-21, followed by three years' research work. *B.Sc.* (Lond.), *M.A.*, *M.Sc.*, *Ph.D.* (Cantab.). During the First World War he was engaged as a junior analyst at a national shell-filling factory. In 1925 he was appointed assistant lecturer in chemistry at Faraday House Engineering College, was placed in charge of the chemical laboratory in 1931, and became Principal in 1937. He left in 1958 to take a post in the Thapar Institute of Engineering and Technology, Patiala, India, of which he became Principal the following year. He was the author of scientific papers and of *Elementary Chemistry for Technical Students* (1931). (*A.* 1921, *F.* 1943) *D.* 31.5.61.

Thomas William Farrer. *B.* 20.3.28. *Ed.* Doncaster Technical College, 1944-46, 1948; Acton Technical College, 1949. He became an analytical chemist at the Royal Ordnance Factory, Ranskill, in 1944. The following year he took a post at British Bemberg Ltd as a shift chemist until 1946, rejoining them in 1948, after a short term of service in the Royal Navy. In 1949 he was appointed an assistant experimental officer at the Chemical Research Laboratory (now National Chemical Laboratory). He resigned in 1955 to undertake research at the University of Cambridge. After gaining his *Ph.D.* (Cantab.) in 1958, he joined Spencer & Partners, Consultants, where he remained until 1960, when he took a post in the research department of Formica Ltd, North Shields. His main hobbies were sailing, climbing and shooting. (*A.* 1951, *F.* 1954) *D.* 3.4.61.

Cornelius Philip Finn. *B.* 17.6.1880. *Ed.* King's School, Pontefract; Yorkshire College (now the University), Leeds, 1897-1901. *B.Sc.* (Manc.), *M.Sc.* (Leeds). In 1901 he became

private assistant to Professor Dobbie at the University College of North Wales, Bangor. Two years later he was appointed chemist in charge of the laboratories of Farnley Iron Co. Ltd, Leeds. In 1908 he took a post as chemist to the South Kirkby, Featherstone & Hemsworth Collieries Ltd, becoming manager of their by-product coking and chemical plants in 1912. He took a similar post at the Manvers Main Collieries Ltd in 1920, and later became general manager of the Hemsworth & United Kingdom Coke Oven Co. Ltd, a position which he held until his retirement in 1950. (*F.* 1917) *D.* 21.5.61.

John George Graymore. *B.* 13.1.1899. *Ed.* University College, Nottingham, 1919-22. *M.Sc.*, *Ph.D.* (Lond.). In 1923 he was appointed science master and lecturer at the People's College, Nottingham. In 1927 he became senior lecturer in science at Newark County Technical College, and three years later was appointed head of the science department at Stockport College for Further Education. Some years later he took a post as head of the chemistry department at the Royal Technical College, Salford. He left in 1945 to become principal of Burnley Municipal College and two years later was appointed principal of Plymouth and Devonport Technical College, a position which he held until his retirement in 1959 owing to ill-health. He was the author of 17 papers in the scientific press. He took a keen interest in all student activities and found time to consider the personal problems of individual students. He will be remembered particularly for the advice and encouragement that he was always ready to give to overseas students and part-time workers. Before his retirement he had the satisfaction of seeing the new technical college at Plymouth well on the way to completion. Outside his work, his interests were centred on his family life and home. His chief hobby was gardening. (*A.* 1927, *F.* 1940) *D.* 23.2.61.

Reginald Arthur McNicol. *B.* 30.4.1899. *Ed.* Sutton County Secondary School; Battersea Polytechnic, 1916-22. *M.Sc.* He began his career in 1922 as a chemist with J. Lyons & Co. Ltd and remained with them until his death, after more than 38 years' service. In 1956 he became a group research chemist responsible for scientific investigation into tea and coffee. Latterly he bravely overcame a number of illnesses and major operations, and was still at work until the day before his death. (*A.* 1927, *F.* 1930) *D.* 12.4.61.

Thomas Malkin. *B.* 28.12.1897. *Ed.* Manchester College of Technology, 1917-19, University of Manchester, 1919-20. *Ph.D.* (Manc.), *D.Sc.* (Lond.). He joined Joseph Crosfield & Sons Ltd as a laboratory assistant in 1913, becoming analytical chemist in 1915 and an assistant research chemist in 1919. He then returned to the Manchester College of Technology to undertake research. In 1925 he was appointed lecturer and reader in organic chemistry in the University of Bristol, a post which he held for the remainder of his life. During the Second World War he was seconded to the Ministry of Supply and was attached to the Research Department, Woolwich. He served for a number of years on the Bristol and District Section of the Institute, including a period as Chairman. He was the author, or joint author, of many scientific papers. (*A.* 1921, *F.* 1945; Council 1947-50) *D.* 25.4.61.

Donald Sanderson Naylor. *B.* 24.12.1897. *Ed.* Queen Elizabeth's School, Blackburn; University of Manchester, 1914-15, 1919-20 (interrupted by service in H.M. Forces). *B.Sc.* Tech. In 1920 he joined the Calico Printers' Association Ltd as a research chemist, and the following year became a senior chemist and departmental under-manager. He left in 1925 to take a post as technical expert and adviser to Bard & Wishart, importers of dyestuffs. In 1926 he became a partner, a position which he retained for the remainder of his life. (*A.* 1921, *F.* 1927) *D.* 7.1.61.

George Christie Redpath. *B.* 16.10.1874. *Ed.* Science and Art School (now Rutherford College of Technology), Newcastle upon Tyne. In 1890 he joined J. & H. S. Pattinson, public analysts and consulting chemists, as a pupil. He remained with the firm as assistant, later becoming chief assistant analyst, a position which he held until his retirement in 1934. During his

long retirement he took a very active part in local welfare organizations, and was the last surviving founder of the Whitley and Monkseaton Welfare Housing Association. He was fond of outdoor life and was a keen member of the Whitley and Monkseaton Bowling Club. (F. 1919) D. 28.4.61.

Thomas Ritchie. B. 11.5.05. Ed. Allan Glen's School, Glasgow; Royal Technical College, Glasgow, 1923-26. B.Sc. In 1927 he became a research chemist at Scottish Dyes Ltd (now Imperial Chemical Industries Ltd). Ten years later he was transferred to Huddersfield. He moved through the various levels of plant management and became a head of department in 1948, a position which he held at the time of his death. He was a member of Huddersfield Music Club and was formerly secretary of Lindley Liberal Ward Committee. He was also a former chairman of the Huddersfield Section of the Institute. (A. 1929) D. 30.5.61.

Ernest Albert Tyler. B. 25.12.1872. Ed. University College, Nottingham, 1892-93; St John's College, Cambridge, 1893-97. M.A. (Cantab.). He was engaged as a science master until 1904, when he joined Swansea Technical College as head of the chemistry department, a position which he retained until his retirement. During the First World War he carried out an inquiry for the Ministry of Munitions on the influence of certain American 'improvers' for petrol and for two years examined (chemically) brasses for soft noses of shells. In 1918 he was engaged as a second lieutenant on East Coast Defence. He served for a number of years on the committee of the South Wales Section of the Institute, and became its Chairman. He was also honorary treasurer of Glamorgan County Cricket Club from 1926 to 1933, and for his services was made an honorary vice-president of the Club for life. (F. 1921; Council 1936-39) D. 5.4.61.

John Wilson. B. 20.11.1872. Ed. Ardwick School, Manchester; Owens College (now University of Manchester), 1891-1894. M.Sc. In 1894 he was appointed demonstrator, and later became lecturer in chemistry, at Battersea Polytechnic (now Battersea College of Technology). He was promoted to head of the chemical department in 1898 and later to Vice-Principal. He left in 1919 on his appointment as H.M. Inspector of Schools, technical branch, at Southampton. He was transferred to Leeds in 1923 and in 1931 to Bristol, where he remained until his retirement in 1933. He was founder secretary of the Association of Teachers in Technical Institutions and held office from 1904 to 1920. He was also a founder member of the Workers' Educational Association. His chief hobby was gardening and he also took an interest in cricket, association football and church architecture. (F. 1909) D. 1.7.61.

THE REGISTER

DEATHS

Fellows

FITCH, Arthur James. Died 13 August, 1961, aged 81. F. 1918.

(P) ILLINGWORTH, Stewart Roy, D.Sc.(LOND.). Died 10 August, 1961, aged 75. A. 1911, F. 1918.

(OK) NAYLOR, Ralph Francis, B.Sc., Ph.D.(LOND.). Died 6 August, 1961, aged 39. A. 1942, F. 1950.

(P) SHELDON, Norman. Died 18 July, 1961, aged 69. A. 1917, F. 1942.

Associates

(OF) BHAVE, Vishnu Mahadeo, M.Sc., Ph.D.(BOMBAY). Died 1 July, 1961, aged 53. A. 1942.

(P) FAIRHALL, Edwin Jesse. Died 29 July, 1961, aged 82. A. 1904.

(K) HAMILTON, Robert Russell, M.A., B.Sc.(GLAS.). Died 31 July, 1961, aged 78. A. 1917.

(Q) MILLS, Harold Alfred Thomas, B.Sc.(LOND.). Died 15 March, 1961, aged 54. A. 1928.

LOCAL SECTIONS DIARY

Sections are glad to welcome members of other Sections to their meetings and social functions, except when numbers are restricted, as for works visits. Those wishing to attend meetings outside their own area are advised to write to the Hon. Secretary of the Section concerned, as the Institute cannot accept responsibility for any alterations or cancellations. All times are p.m. except where otherwise stated. For key to Local Sections see J., 233.

- (A) **Aberdeen.** 18 Oct. 8. Recent Advances in Gas Chromatography and its Application to Biochemistry. Dr A. T. James. Chemistry Department, Old Aberdeen. Joint, C.S. and S.C.I.
- (B) **Belfast.** 10 Oct. 7.45. The Mechanism of Detergent Action. Prof. N. K. Adam. Queen's University. Joint, C.S. and S.C.I.
- (X) **Billingham.** 18 Oct. 7.45. Exhibition of Scientific Films, Synthonia Theatre
- (R) **Bournemouth.** 26 Oct. 7.30. Wine Making. R.B. Brock. Municipal College. Joint, Inst. Pet. and Pharmaceutical Soc.
- (D) **Bridgwater.** 12 Oct. 6.30. Solid-Fuel Rocket Propulsion. Dr G. H. S. Young. British Cellophane Ltd. Joint, C.S. and S.C.I.
- (P) **Brighton.** 10 Oct. 7. Chemical Control of Plant Growth. Prof. R. L. Wain. Technical College. Joint, College Chem. Soc.
- (P) **Cambridge.** 18 Oct. 7.45. The Stereochemistry of Nitrogen and Phosphorus. Dr F. G. Mann. Technological Research Station, Spillers Ltd, Station Road. Joint, S.C.I.
- (EE) **Carlisle.** 6 Oct. 7.30. The History of the Dyestuffs Industry in Carlisle. Dr F. H. Day. Technical College
- (P) **Chatham.** 24 Oct. 7.30. Paramagnetic Resonance and its Applications. Prof. J. Ingram. Alfred College, Technology, Maidstone Road
- (T) **Connaught Quay.** 29 Sept. 2.30. Women in Technology. Miss M. Olliver. Flintshire Technical College
- (P) **Dagenham.** 19 Oct. 7. Chemical Patents. Dr S. I. Levy. South-East Essex Technica College. Joint, College Sci. Soc.
- (H) **Derby.** 28 Sept. 7.30. Treatment of Papermill and Chemical Plant Effluents with special reference to Prevention of Pollution. T. Waldmeyer. Derby and District College of Technology, Kedleston Road
- (FF) **Dundee.** 20 Oct. 7.15. Science and the Police Surgeon. Dr W. F. Dorward. Technical College, Bell Street
- (P) **Ewell.** 9 Oct. 7. Organic Derivatives of Coinage Metals. Prof. G. E. Coates. County Technical College, Reigate Road. Joint, Ewell County Technical College and Kingston Technical College Chem. Soc.
- (WW) **Falkirk.** 4 Oct. 7.30. The Changing Face of Organic Chemistry. Prof. F. Bell. Park Farm, Glasgow
- (K) **Glasgow.** 20-22 Sept. Exhibition of Chemical Laboratory Apparatus. Rooms 302, 304 and 306, Royal College of Science and Technology — 13 Oct. 7.15. Sherry. H. F. Barnes. Royal College of Science and Technology
- (D) **Gloucester.** 19 Oct. 7.30. The Chemistry of Polyamides. A. H. Hill. Joint, C.S., S.C.I. and Plastics Inst.
- (L) **Huddersfield.** 17 Oct. 7.30. Some Aspects of Management Selection. P. H. Silvio's Restaurant, Westgate. Joint, Soc. of Dyers and Colourists
- (M) **Hull.** 4 Oct. 7.30. Film Show. Francis Reckitt Institute — 26 Oct. 7.30. Sherry. T. Laycock. Royal Station Hotel
- (G) **Ipswich.** 24 Oct. 7. A.G.M., followed by talk on the Journal. Dr F. A. Robinson. Oriental Café, Westgate Street
- (SS) **Lancaster.** 27 Oct. 7.30. Determination of Foreign Oils in Edible Oils and Fats. B. G. Crump. Technical College, Torrisholme Road. Joint, S.A.C.
- (N) **Leeds.** 24 Oct. 6.30. Steric Hindrance in Analytical Chemistry. Prof. H. M. N. H. Irving. Chemistry Lecture Theatre, The University. Joint, University Chem. Soc.
- (O) **Liverpool.** 5 Oct. 7. Chairman's Address: Modern Food Legislation. G. H. Turner. Donnan Laboratories, The University — 10 Oct. 6. Chemical Education Meeting. Debate on Motion: 'That the Concept of Equivalent Weight is now Superfluous.' Education Department, The University. Joint, S.M.A. — 25 Oct. 7. New Reactions, New Polymers. Prof. R. N. Haszeldine. Donnan Laboratories, The University
- (P) **London.** 27 Oct. Annual Dinner and Dance. Waldorf Hotel, Aldwych, W.C.2
- (Q) **Manchester.** 4 Oct. 9 a.m. Symposium on Polymers of the 1960s. Department of Chemistry, The University
- (G) **Manningtree.** 28 Sept. 6. Analytical Research. Dr J. Haslam. B.X. Plastics Ltd Research Station, Lawford Place
- (SS) **Morecambe.** 29 Sept. 8.30. Plastics Related to Petroleum. Dr T. S. McRoberts. Grosvenor Hotel. Joint, Inst. Pet.
- (S) **Newcastle upon Tyne.** 19 Oct. 6.30. Oxidation of Organic Compounds: Some Recent Work. Prof. H. B. Henbest. Chemistry Department, King's College. Joint, C.S.
- (E) **Newport.** 20 Sept. 7. Recent Developments in the Chemical Applications of Nuclear Resonance Spectroscopy. Dr R. E. Richards. College of Technology, Allt-yr-yn. Joint, S.C.I.
- (X) **Norton.** 4 Oct. 8. A.G.M. William Newton School
- (H) **Nottingham.** 27 Oct. 7.30. Ladies' Evening. Wine and Cheese. Miss Roberts and Mr W. A. Rook. Boots Institute, Trent Bridge. Joint, S.C.I.
- (R) **Portsmouth.** 13 Oct. 7. The Chemistry of Wines and Spirits. Dr E. C. Barton-Wright. College of Technology. Joint, Portsmouth and District Chem. Soc.
- (SS) **Preston.** 3 Oct. 7. Ion-Exchange Resins. Dr E. Gripp. Harris College. Joint, College
- (Y) **Reading.** 17 Oct. 7. Scientific Techniques in Art and Archaeology. Dr A. E. Werner. Zoology Lecture Theatre, The University
- (R) **Salisbury.** 20 Oct. 7.45. Trace Analysis in Archaeology. Dr E. T. Hall. Red Lion Hotel. Joint, S.A.C.
- (C) **Solihull.** 29 Sept. 8. Annual Dinner and Dance. George Hotel
- (SS) **Ulverston.** 20 Oct. 6.30. The Uses and Limitations of Modern Industrial Plastics. W. Taylor. Sun Hotel. Joint, Glaxo Laboratories Sci. Soc.
- (T) **Wrexham.** 25 Oct. 7. Analytical Instrumentation of Process Gas Streams with particular reference to Gas Chromatography. J. C. Hawkes. Denbighshire Technical College